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California Univ., Berkeley

Prepared for

Health Effects Research Lab.
Research Triangle Park, NC

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ASBESTOS SAMPLING PLAN FOR THE SAN FRANCISCO BAY AREA, CALIFORNIA

by

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Purchase Order #C3253NAET

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OFFICE OF RESEARCH AND DEVELOPMENT
U.S. ENVIRONMENTAL PROTECTION AGENCY
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16. ABSTRACT

This research project was initiated to facilitate the use of waterborne asbestos data for a possible case-control epidemiological study of ingested asbestos in five Bay Area counties near San Francisco, California. For each county, and each census tract within the area, information about historical water supply and distribution, water treatment practices, and asbestos levels has been compiled. It was determined that none of the major water districts servicing the San Francisco Bay Area are free of asbestos fibers. Individual asbestos measurements range in value from less than 10^4 fibers per liter to 1.8×10^8 fibers/liter of finished water. It was determined that a sampling protocol to augment the current asbestos data base should include sampling the largest flows of water and should take into consideration: variation within the distribution system, possible seasonal variation, the drought of 1976-1978, and the historical waterborne asbestos levels.

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FOREWORD

The many benefits of our modern, developing, industrial society are accompanied by certain hazards. Careful assessment of the relative risk of existing and new man-made environmental hazards is necessary for the establishment of sound regulatory policy. These regulations serve to enhance the quality of our environment in order to promote the public health and welfare and the productive capacity of our Nation's population.

The complexities of environmental problems originate in the deep interdependent relationships between the various physical and biological segments of man's natural and social world. Solutions to these environmental problems require an integrated program of research and development using input from a number of disciplines. The Health Effects Research Laboratory, Research Triangle Park, NC and Cincinnati, OH, conducts a coordinated environmental health research program in toxicology, epidemiology, and clinical studies using human volunteer subjects. Wide ranges of pollutants known or suspected to cause health problems are studied. The research focuses on air pollutants, water pollutants, toxic substances, hazardous wastes, pesticides, and nonionizing radiation. The laboratory participates in the development and revision of air and water quality criteria and health assessment documents on pollutants for which regulatory actions are being considered. Direct support to the regulatory function of the Agency is provided in the form of expert testimony and preparation of affidavits as well as expert advice to the Administrator to assure the adequacy of environmental regulatory decisions involving the protection of the health and welfare of all U.S. inhabitants.

This report has been prepared to facilitate the use of waterborne asbestos data in possible future studies of ingested asbestos in the San Francisco Bay Area of California.

F. Gordon Hueter, Ph.D.
Director
Health Effects Research Laboratory

ABSTRACT

This research project was initiated to facilitate the use of waterborne asbestos data for a possible case-control epidemiological study of ingested asbestos in five Bay Area counties near San Francisco, California. For each county, and each census tract within the area, information about historical water supply and distribution, water treatment practices, and asbestos levels has been compiled. It was determined that none of the major water districts servicing the San Francisco Bay Area are free of asbestos fibers. Individual asbestos measurements range in value from less than 10^4 fibers per liter to 1.8×10^8 fibers/liter of finished water. It was determined that a sampling protocol to augment the current asbestos data base should include sampling the largest flows of water and should take into consideration: variation within the distribution system, possible seasonal variation, the drought of 1976-1978, and the historical waterborne asbestos levels.

This report was submitted in fulfillment of Purchase Agreement #C3253NAET by the University of California under the sponsorship of the U.S. Environmental Protection Agency. This report covers a period from April 1980 to June 1981.

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SECTION 1

INTRODUCTION

This report has been prepared to facilitate the use of waterborne asbestos data in a case control epidemiological study of ingested asbestos. The five Bay Area counties included in this report are San Francisco, Marin, San Mateo, Alameda, and Contra Costa (see Figure 1.). For each county, and each census tract within the area, information about historical water supply and distribution, water treatment practices, and asbestos levels have been compiled. An historical index for asbestos exposure of individuals residing within a census tract in the San Francisco Bay Area can be constructed using existing asbestos level data augmented by new water analyses. Asbestos data summarized in this report was obtained through a study of asbestos in drinking water supplies and cancer incidence conducted at the University of California at Berkeley, from 1974-1976.

An indirect epidemiological approach was used in that study to show that a statistical association exists between the presence of asbestos fibers in drinking water and the incidence of certain cancers among residents served by those water supplies. In particular, the incidence of cancer of the digestive tract and digestive related organs was associated with increasing amounts of asbestos in the drinking water supply of the San Francisco Bay Area. A case control study would be useful in measuring the effects of other variables such as smoking, alcohol consumption, and occupation on this association.

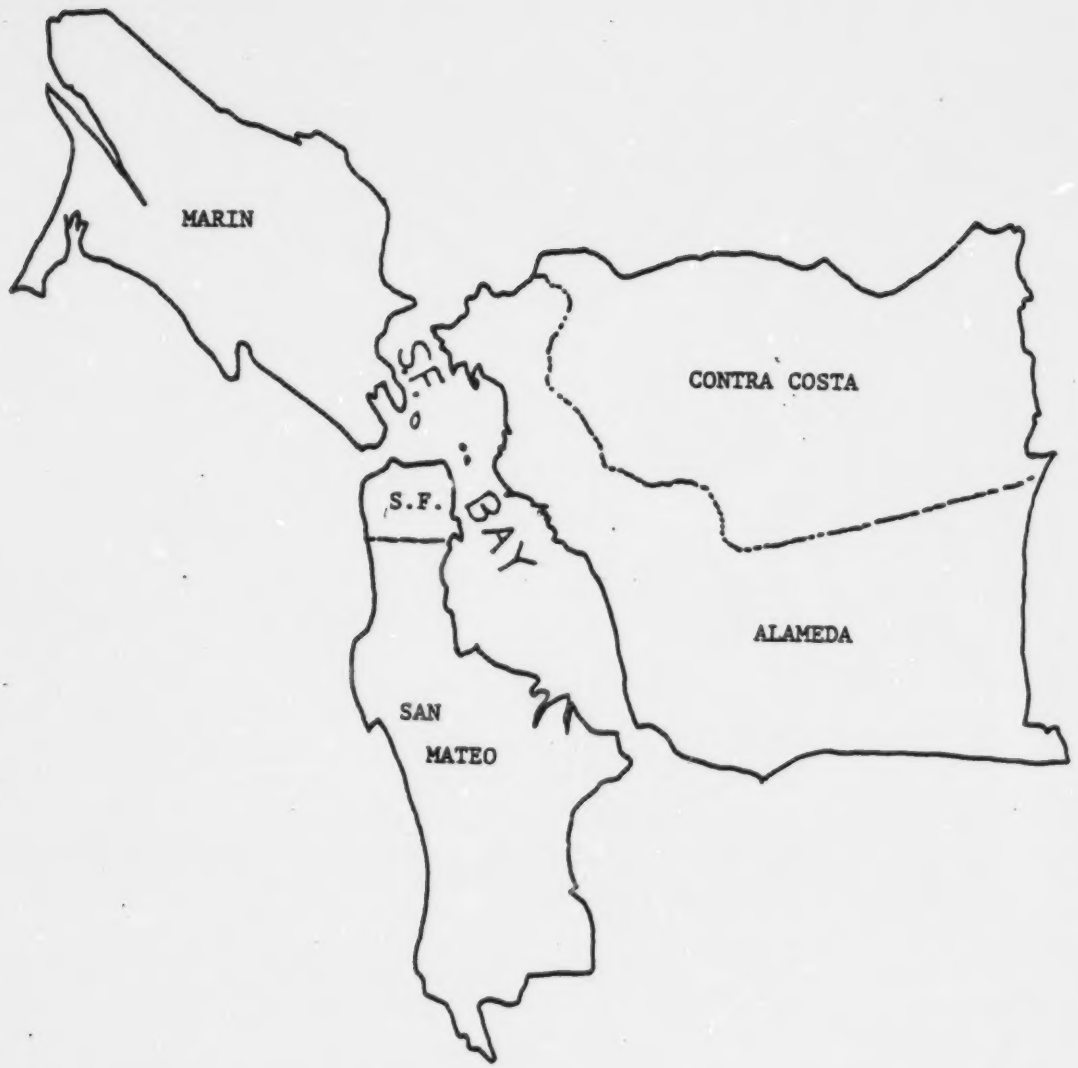


Figure 1. The Bay Area Counties included in this report

SECTION 2

SAN FRANCISCO AND SAN MATEO COUNTIES

San Francisco Water Department

San Francisco's earliest supply of drinking water was provided by local spring water. In 1851, water was transported to the city by barge from Marin County. In 1857, San Francisco Waterworks was organized to develop the supply at Lobos Creek. The water was conveyed to Black Point on San Francisco's northern shore, then pumped to the reservoirs at Lombard and Francisco Streets for distribution. Lobos Creek water is still utilized in the San Francisco Presido.

The Spring Valley Waterworks was organized in 1860. The company was active in developing two major "systems" for the production of drinking water for San Francisco, these being the Peninsula and Alameda systems. The Peninsula system consisted of Lake Pilarcitos, in San Mateo County, which was constructed to entrap runoff from the Peninsula watershed area. Water was delivered from this reservoir via pipeline to Lake Honda Reservoir in San Francisco in 1852. The Peninsula system was later augmented by construction of San Andreas Reservoir in 1868, Upper Crystal Springs Reservoir in 1877, and Lower Crystal Springs Dam in 1887. Excess water from Pilarcitos Reservoir was diverted into San Andreas Reservoir. Water from San Andreas Reservoir and Crystal Springs was delivered to San Francisco by gravity via a series of transmission lines.

The Alameda division consisted mainly of Calaveras Reservoir, constructed in 1925 for the impoundment of local watershed water, supplemented by two underground sources. These underground sources consist of the Sunol Filter galleries and the Pleasanton well fields, which deliver water to Sunol via pipeline; the water from Sunol is piped across the bay to Crystal Springs. During the time when Spring Valley Company served the city of San Francisco, the city had been studying the development of an independent municipally-owned system and source

of supply. This led to the development of the Hetch Hetchy Project in 1913 to import Tuolumne River water from the Sierra Nevada Mountains. Because the city needed a means for distributing this water, it began negotiations for acquiring the Spring Valley Company. In 1930, the city acquired ownership of the company, and the first water from Hetch Hetchy was delivered to Crystal Springs Reservoir in 1934.

Crystal Springs Reservoir in San Mateo County is located thirteen miles south of San Francisco. Besides providing catchment for local runoff, Crystal Springs is the terminal for Hetch Hetchy water. In addition, water from the Alameda system is transported via the Hetch Hetchy aqueduct across San Francisco Bay into Crystal Springs. Water from Crystal Springs is delivered by gravity to University Mound Reservoir in San Francisco. The water from these transmission lines can be diverted to a San Andreas line if necessary. San Andreas Reservoir is located just north of Crystal Springs. Runoff from the San Andreas and Pilarcitos watersheds, supplemented by water pumped from Crystal Springs into San Andreas Reservoir is delivered by gravity to four terminal reservoirs in San Francisco.

Prior to 1965, the only treatment of Alameda source waters was aeration and chlorination before distribution to users in Alameda County. Water from Crystal Springs and San Andreas Reservoirs was simply chlorinated before distribution to San Francisco and parts of San Mateo County. However, the problem of high turbidities and the presence of objectionable taste, odor, and color in the Alameda sources led to the construction of Sunol treatment plant in 1965. The Sunol treatment plant was constructed to treat all water from the Alameda system before distribution, utilizing flocculation with alum and silica, sedimentation, polyelectrolyte, filtration, and chlorination.

The distribution system in San Francisco is complicated due to the many hills in different locations throughout the city, ranging in elevation from sea-

level to nine hundred feet. There are some 25 different pressure districts throughout the city. These districts vary in outline and area and are often served by more than one source. As San Francisco grew in population, many changes and additions were made: Figure 2 shows the areas served by the various reservoir systems in San Francisco. Lake Honda was constructed in 1861 to receive water from Pilarcitos Creek. It was replaced in 1938 by Sunset Reservoir, serving the same district as Lake Honda. Lake Honda is now used for storage and emergency operations. This reservoir served the northwestern part of the city with extensions to the east and southwest. Merced Manor, constructed in 1926 and located in the southwestern part of the city, supplies the areas of the city adjoining the Pacific Ocean. Water from this reservoir is pumped into Stanford Heights Reservoir which serves the hillsides near the center of the city. College Hill Reservoir was constructed in 1870 to receive water from San Andreas Reservoir, and serves the area west of University Mound.

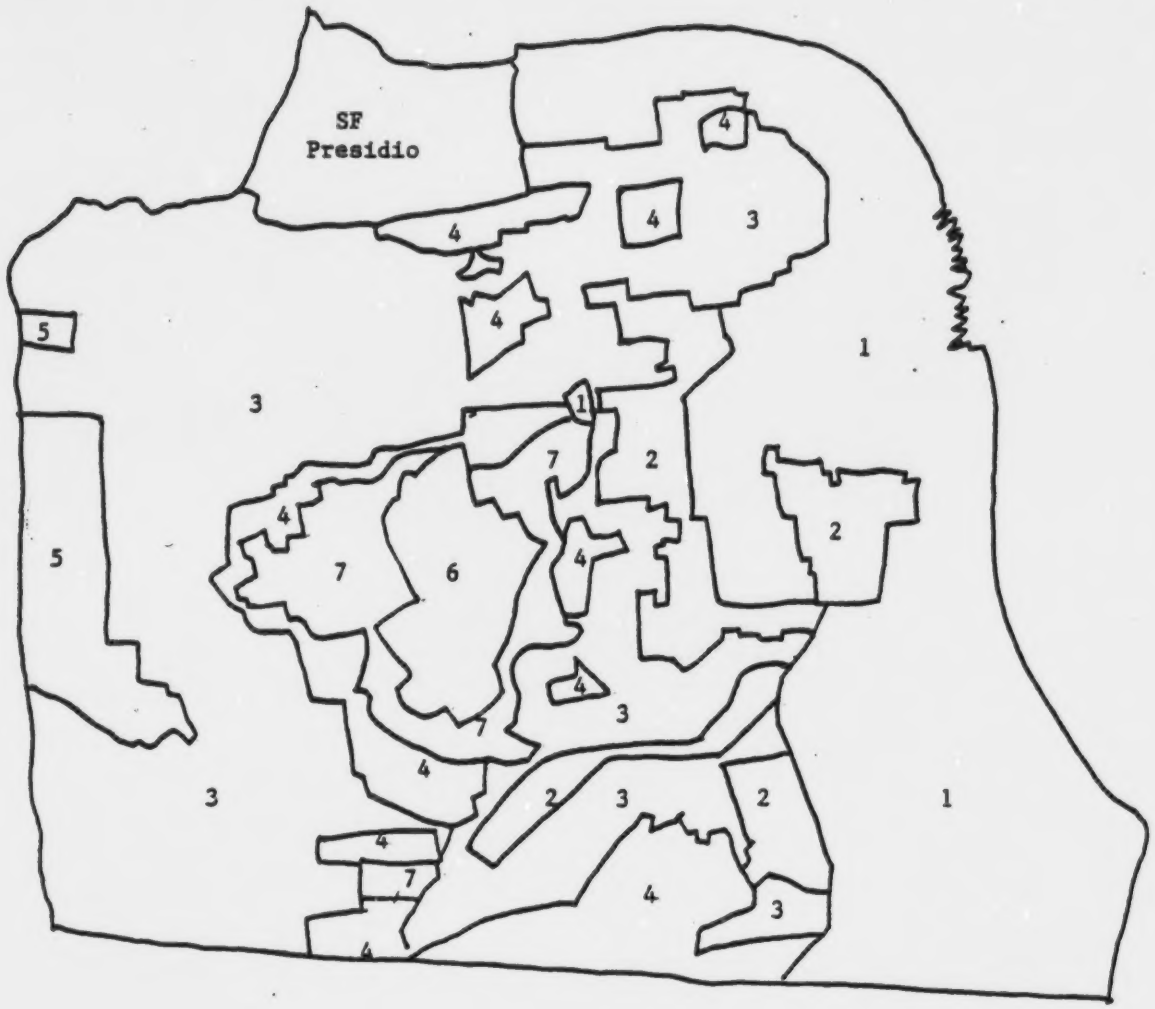
Cross town pipelines and the Alemany pumping station completed in 1942 make it possible to transfer water between University Mound, College Hill, and Sunset systems in either direction. The completion of the Sunset Supply line in 1958 allowed water from either Crystal Springs or San Andreas to be delivered to Sunset Reservoir. As water consumption increased in the Sunset service area, very little water reached Sunset Reservoir directly from San Andreas Reservoir, although much of the service area was still supplied by San Andreas.

Two major changes in the storage/distribution system for San Francisco were completed in 1971 and 1972: the construction of the Crystal Springs bypass tunnel and the San Andreas treatment plant. The bypass tunnel was constructed to minimize the addition of treated Alameda water from the Sunol treatment plant to untreated Peninsula water, and permitted Hetch Hetchy water to be delivered directly to customers, although in periods of peak demand, untreated Crystal Springs

water had to be used. The completion of Crystal Springs balancing reservoir in 1975 allows storage of Hetch Hetchy and treated Alameda water to be used during these periods. However, untreated Crystal Springs water is still used occasionally. The San Andreas treatment plant treats all water from Crystal Springs and San Andreas Reservoir before distribution. Like the Sunol treatment plant, the San Andreas plant utilizes alum and silica flocculation, sedimentation, polyelectrolyte, activated carbon, filtration, and chlorination.

San Mateo County

San Mateo County is served by numerous small water suppliers, most of whom purchase water from the San Francisco Water Department and distribute it without further treatment. The communities north of Crystal Springs Reservoir are serviced either by Crystal Springs or San Andreas, while the area south of the reservoirs is serveced directly from the Hetch Hetchy pipelines. Any historical changes occuring in San Francisco's drinking water would apply to these communities.



1. University Mound
2. College Hill
3. Sunset (Lake Honda)
4. Sutro
5. Merced Manor
6. Summit
7. Stanford Heights

Figure 2. Water distribution for San Francisco

RESERVOIR SYSTEM	NO. SAMPLES (TRACT NO.)	SOURCE
Sunset and University Mound	3(107, 129)	Crystal Springs & San Andreas
University Mound and College Hill	6(117, 227, 228)	Crystal Springs & San Andreas
University Mound	3(208, 231)	Crystal Springs
Sunset and College Hill	4(254, 257)	Crystal Springs & San Andreas
Sunset and Sutro	1(263)	Crystal Springs & San Andreas
Sunset	11(327, 329)	Crystal Springs & San Andreas
Stanford Heights, Sunset & Sutro	2(301)	Crystal Springs & San Andreas

Figure 3. Number of samples and census tracts previously sampled in San Francisco

TABLE 1. HISTORICAL WATER SUPPLY - SAN FRANCISCO

CITY RESERVOIR	DATE	SOURCE	STORAGE/TRANSMISSION	TREATMENT
University Mound	1916	Alameda Watershed and Crystal Springs Watershed	Crystal Springs Reservoir	
College Hill Lake Honda		San Andreas and Pilarcitos Watersheds	San Andreas Reservoir	
University Mound	1930	Alameda sources and Crystal Springs Watershed	Crystal Springs Reservoir	Chlorination
College Hill Lake Honda		Local watershed supplemented with Crystal Springs	San Andreas Reservoir	Chlorination
Stanford Heights		Local watershed supplemented with Crystal Springs	Lake Honda Reservoir	
University Mound	1934	Tuolumne River (Hetch Hetchy) Alameda and Crystal Springs Watersheds	Crystal Springs Reservoir	Chlorination
College Hill Lake Honda Merced Manor Sunset		Local watershed supplemented with Crystal Springs	San Andreas Reservoir	Chlorination
Stanford Heights		Local watershed supplemented with Crystal Springs	Merced Manor Reservoir	
University Mound	1958	Tuolumne River, Alameda and Crystal Springs Watersheds	Crystal Springs Reservoir	Chlorination Flouridation (1952)
College Hill Merced Manor		Crystal Springs and Local Watersheds	San Andreas Reservoir	Chlorination Flouridation (1952)

TABLE 1 (continued)

CITY RESERVOIR	DATE	SOURCE	STORAGE/TRANSMISSION	TREATMENT
Stanford Heights	1958	Crystal Springs and Local Watersheds	Merced Manor Reservoir	
Sunset		Tuolumne River and local watershed	San Andreas and Crystal Springs Reservoirs	Chlorination and Flouridation
Sutro		Tuolumne River and local watershed	Crystal Springs Reservoir	Chlorination and Flouridation
Summit		Sutro	Sutro	
	1965	Alameda Watershed sources	Sunol Valley Treatment Plant	Alum & silica flocculation, polyelectrolyte, sedimentation filtration, chlor.
University Mound	1972	Tuolumne and treated Alameda sources	Crystal Springs bypass tunnel	San Andreas treatment process
College Hill Merced Manor		Crystal Springs and local watershed	San Andreas treatment plant	Alum & silica flocculation, polyelectrolyte, activated carbon, filtration, fluoridation, chlor.
Sutro		Tuolomne and Alameda sources	Crystal Springs bypass tunnel	San Andreas treatment process
nset		Tuolomne, local, and treated Alameda watershed	Crystal Springs bypass tunnel and San Andreas treatment plant	alum & silica flocculation, polyelectrolyte, activated carbon, filitration chlorination, fluor.
Stanford Heights		Crystal Springs, local watershed	Merced Manor	

TABLE 2. WATER SUPPLY FOR SAN FRANCISCO BY CENSUS TRACT

TRACT	SYSTEM†	SOURCE§	HISTORICAL SYSTEM/SOURCE*	SAMPLE DATA	ASBESTOS X 10^6/L
101	UH	1	UH,3		
102	UH,Sut,Sun	1	UH,3		
103	Sun,Sut	1,2	Sun,Sut, 4,3(50), Hon, 4		
104	UH,Sun	1,2	UH,Sun, 3,4(38), UH,Hon, 3,4		
105	UH	1	UH,3		
106	UH,Sun	1,2	UH,Sun 3,4(38), UH,Hon, 3,4	12/76,8/77	2.5,21
107	Sun,UH	1,2	Sun,UH, 3,4(38), Hon,Sun, 3,4		
108	Sut,Sun	1,2	Sut,Sun, 3,4(50), Hon,4		
109	Sun,Sut	1,2	Sun,Sut 3,4(50), Hon,SH, 4		
110	Sun,Sut	1,2	Sun,Sut 3,4(50), Hon,SH, 4		
111	Sun	1	Sun,4(38), Hon,4		
112	Sut	1,2	Sut,3(50), SH,4		
113	Sun	1,2	Sun,4(38), Hon,4		
114	UH,Sun	1	UH,Sun, 3,4(38), UH,Hon, 3,4		
115	UH	1	UH,3		
116	UH	1	UH,3	6/73,7/74,12/74	1,0.2,BDL
117	UH,CH	1,2	UH,CH, 3		
118	UH,Sun	1,2	UH,Sun, 3,4		
119	Sun	1,2	Sun,3,4(38), Hon,4		
120	Sun,CH	1,2	Sun,CH, 4,3		
121	Sun,CH	2,1	Sun,CH, 4,3		
122	CH,Sun	1	CH,Sun, 3,4		
123	CH,UH	1	CH,UH, 3		
124	CH,UH	1	CH,UH, 3		
125	UH,CH	1	UH,CH		
126	UH	1	UH,3		
127	UH	1	UH,3		
128	UH,Sun	1,2	UH,Sun, 3,4(38), UH,Hon, 3,4	12/76	0.65
129	UH,Sun	1,2	UH,Sun, 3,4(38), UH,Hon, 3,4		
130	Sun	1,2	Sun,3,4(58), Sun,4(38), Hon,4		
131	Sun,Sut	1,2	Sun,Sut, 3,4(50), Hon,4		
132	Sun,Sut	1,2	Sun,Sut, 3,4(50), Hon,4		
133	Sut,Sun	1,2	Sut,Sun, 3,4(50), Hon,SH, 4		
134	Sun,Sut	1,2	Sun,Sut, 3,4(50), Hon,SH, 4		
135	Sut,Sun	1,2	Sut,Sun, 3,4(50), SH,Hon, 4		
151	Sun,Sut	1,2	Sun,Sut, 3,4(50), SH,Hon, 4		
152	Sun,Sut	1,2,3	Sun,Sut, 3,4(50), Hon,SH, 4		
153	CH,Sun	1,2	CH,Sun, 3,4(38), CH,Hon, 3,4		
154	Sun,Sut	1,2	Sun,Sut, 3,4(50), Hon,SH, 4		
155	Sun,CH	1,2	Sun,CH, 4,3(38), Hon,CH, 4,3		

TABLE 2 (continued)

TRACT	SYSTEM†	SOURCE§	HISTORICAL SYSTEM/SOURCE*	SAMPLE DATA	ASBESTOS X 10^6/L
156	Sun,Sut	1,2	Sun,Sut, 3,4(38), Hon,SH, 4		
157	Sun,Sut	1,2	Sun,Sut, 3,4(38), Hon,SH, 4		
158	Sun,CH	1,2	Sun,CH, 4,3(38), Hon,CH, 4,3		
159	Sun,CH	1,2	Sun,CH, 4,3(38), Hon,CH, 4,3		
160	Sun,CH	1,2	Sun,CH, 4,3(38), Hon,CH, 4,3		
161	CH,Sun	1,2	CH,Sun, 3,4(38), CH,Hon, 3,4		
162	CH	1	CH,3		
163	CH,Sun	1,2	CH,Sun, 3,4(38), CH,Hon, 3,4		
164	Sun	1,2	Sun,4(38), Hon,4		
165	Sun,Sut	1,2	Sun,Sut, 4,3(50), Hon,SH, 4		
166	Sun	1,2	Sun,4(38), Hon,4		
167	Sun,UM,SH	1,2	Sun,UM,SH, 3,4		
168	CH,Sun	1,2	CH,Sun, 3,4(38), CH,Hon, 3,4		
169	CH,Sun	1,2	CH,Sun, 3,4(38), CH,Hon, 3,4		
170	SH	2	SH,4		
171	SH,Sut	2,1	SH,Sut, 4,3(50), SH,4		
176	UM	1	UM,3		
177	UM,CH	1	UM,CH, 3		
178	UM	1	UM,3		
179	UM	1	UM,3		
180	UM	1	UM,3		
201	UM	1	UM,3		
202	CH	1	CH,3		
203	CH,Sun	1,2	CH,Sun, 3,4(38), CH,Hon, 3,4		
204	SH,Sum,Sun	2,1	SH,Sut,Sun, 4,3(50), SH,Hon, 4		
205	Sum,Sut,SH	1,2	Sun,Sut, SH(50), Hon,SH, 4		
206	Sun,Sut	1,2	Sun,Sut, 4,3(50), Hon,SH, 4		
207	CH	1	CH,3		
208	UM	1	UM,3	8/77	15
209	CH,UM	1	CH,UM, 3		
210	CH	1	CH,3		
211	Sun,Sut	1,2	Sun,Sut, 4,3(50), Hon,SH, 4		
212	Sut,SH	1,2	Sut,SH, 3,4(50), SH,4		
213	Sut,SH,Sun	1,2	Sut,SH,Sun, 3,4(50), SH,Hon, 4		
214	Sun,CH	1,2	Sun,CH, 4,3(38), Hon,CH, 4,3		
215	CH,Sun	1,2	CH,Sun, 3,4(38), CH,Hon, 3,4		
216	SH,Sun,Sut	1,2	SH,Sun,Sut, 4,3(50), SH,Hon, 4		
217	SH,Sun,Sut	1,2	SH,Sun,Sut, 4,3(50), SH,Hon,4		
218	Sun,CH	1,2	Sun,CH, 4,3(38), Hon,CH, 4,3		

TABLE 2 (continued)

TRACT	SYSTEM†	SOURCE§	HISTORICAL SYSTEM/SOURCE*	SAMPLE DATA	ASBESTOS X 10^6/L
226	UM	1	UM,3		
227	CH,UM	1	CH,UM, 3	12/76	1.8
228	UM,CH	1	UM,CH, 3	12/76,8/77	0.98,10
229	UM,CH	1	UM,CH, 3		
230	UM	1	UM, 3		
231	UM	1	UM, 3	12/76,8/77	0.5,31
232	UM	1	UM, 3		
233	UM	1	UM, 3		
234	UM	1	UM, 3		
251	CH,Sun	1,2	CH,Sun, 3,4(38), CH,Hon, 3,4		
252	Sun,CH	1,2	Sun,CH, 4,3(38), Hon,CH, 4,3		
253	Sun,CH	1,2	Sun,CH, 4,3(38), Hon,CH, 4,3		
254	Sun,CH	1,2	Sun,CH, 4,3(38), Hon,CH, 4,3	12/76,2/77	2.3,0.4
255	Sun,CH	1,2	Sun,CH, 4,3(38), Hon,CH, 4,3		
256	Sun,CH	1,2	Sun,CH, 4,3(38), Hon,CH, 4,3		
257	Sun,CH	1,2	Sun,CH, 4,3(38), Hon,CH, 4,3	12/76,8/77	1.25,30 0.25
258	UM	1	UM,3		
259	CH	1	CH,3		
260	Sun,Sut	1,2	Sun,Sut, 4,3(50), Hon,SH, 4		
261	CH,Sun	1,2	CH,Sun, 3,4(38), CH,Hon, 4		
262	Sun	1,2	Sun,4,3(58), Sun,4(38), Hon,4		
263	Sut,Sun	1,2	Sut,Sun, 3,4(50), SH,Hon, 4	12/76	0.78
264	UM,Sun	1,2	UM,Sun, 3,4(38), UM,Hon, 3,4		
301	SH,Sut,Sun	2,1	SH,Sut, 4,3(50), SH,4	5/77,5/78	22,0.77
302	Sun,Sut	1,2	Sun,Sut, 4,3(50), Hon,SH, 4		
303	SH,Sum,Sut	2,1	SH,Sut, 4,3(50), SH,4		
304	SH,Sum	2,1	SH,4		
305	Sum	1	SH,4		
306	Sum,SH	1,2	SH,4		
307	Sum,SH	1,2	SH,4		
308	SH,Sut,Sun	2,1	SH,Sut,Sun, 4,3(50), SH,Hon, 4		
309	Sun,SH,Sut	1,2	Sun,SH,Sut, 3,4(50), Hon,SH, 4		
310	SH,Sut,Sun	1,2	SH,Sut,Sun, 4,3(50), SH,Hon, 4		
311	Sut,Sun,SH	1,2	Sut,Sun,SH, 3,4(50), SH,Hon, 4		
312	Sut,Sun,SH	1,2	Sut,Sun,SH, 3,4(50), SH,Hon, 4		
313	Sun,Sut	1,2	Sun,Sut, 4,3(50). Hon,SH, 4		
314	SH,Sut,Sun	2,1	SH,Sut,Sun, 4,3(50), SH, Hon, 4		

TABLE 2 (continued)

TRACT	SYSTEM†	SOURCE§	HISTORICAL SYSTEM/SOURCE*	SAMPLE DATA	ASBESTOS X 10^6/L
326	Sun	1,2	Sun,3,4(58), Sun,4(38), Hon,4		
327	Sun	1,2	Sun,3,4(58), Sun,4(38), Hon,4	7/77 (10 samples)	14,24,55,20,15,14,58, 13,26,44
328	SH,Sut,Sun	2,1	SH,Sut,Sun, 4,3(50), SH,Hon, 4		
329	Sun	1,2	Sun,3,4(58), Sun,4(38), Hon,4	12/76	1.4
330	Sun	1,2	Sun,3,4(58), Sun,4(38), Hon,4		
331	Sun,MM	1,2	Sun,MM, 4(38), Hon,4		
332	Sun	1,2	Sun, 3,4(58), Sun,4(38), Hon,4		
351	Sun,MM	1,2	Sun,MM, 4(38), Hon,4		
352	MM	2	MM,4(36), Hon,4		
353	Sun,MM	1,2	Sun,MM, 4(38), Hon 4		
354	MM	2	MM,4(36), Hon,4		
401	Sun,Sut	1,2	Sun,Sut, 4,3(50), Hon,4		
402	Sun	1,2	Sun, 3,4(58), Sun,4(38), Hon,4		
426	Sun	1,2	Sun, 3,4(58), Sun,4(38), Hon,4		
427	Sun	1,2	Sun, 3,4(58), Sun,4(38), Hon,4		
428	Sun	1,2	Sun, 3,4(58), Sun,4(38), Hon,4		
451	Sun	1,2	Sun, 3,4(58), Sun,4(38), Hon,4		
452	Sun	1,2	Sun, 3,4(58), Sun,4(38), Hon,4		
476	Sun	1,2	Sun, 3,4(58), Sun,4(38), Hon,4		
477	Sun	1,2	Sun, 3,4(58), Sun,4(38), Hon,4		
478	Sun	1,2	Sun, 3,4(58), Sun,4(38), Hon,4		
479	Sun	1,2	Sun, 3,4(58), Sun,4(38), Hon,4		
607	UM	1	UM,3		
608	UM	1	UM,3		
609	UM	1	UM,3		
610	UM	1	UM,3		

†: UM - University Mound, CH - College Hill, Sun - Sunset, SH - Stanford Heights, Sut - Sutro, Sum - Summit
Hon - Honda

§: 1 - Bypass Tunnel (1972)
2 - San Andreas treatment plant (1972)
3 - Crystal Springs
4 - San Andreas

*(date): year change occurred

WATER UTILITY	SOURCE
A. Coastside County	Surface and Crystal Springs
B. Citizens' Utility and Coastside County	Surface and wells
C. Coastside County	Surface
D. Coastside County and Skyline Co.	Surface and Crystal Springs
E. See Figure 5.	

Figure 4. Water source and utilities servicing San Mateo County

O.	UTILITY	SOURCE	NO. SAMPLES/ NO. TRACTS
	Daly City	C.S.,S.A.,wells	
	Dimond	C.S.	
	CWS, Broadmoor	C.S.,S.A.,wells	1/1
	Brisbane	C.S.	2/1
	CWS, S. S.F.	C.S.,S.A.	
	Westborough	S.A.	2/2
	North Coast	S.A.	2/2
	San Bruno	weels	4/2
	Millbrae	C.S.,S.A.	8/2
0	Hillsborough	C.S.	1/1
1	SCW, San Mateo	C.S.	3/3
2	Estero	C.S.	4/2
3	Belmont	H.H.,C.S.	7/4
4	CWS, San Carlos	H.H.	3/2
5	Redwood City	H.H.	6/4
6	CWS, Bear. & Skyline	H.H	
7	CWS, Beargulch	H.H.	2/2
8	Menlo Pk., CWS, & Bear.	H.H.	5/2
9	Menlo Park	H.H.	1/1
0	East Palo Alto	H.H.,wells	1/1
1	CWS, Bear, & L. Tran.	H.H.	

Figure 5. Water districts previously sampled for asbestos in parts of San Mateo County

TABLE 3. WATER SUPPLY - SAN MATEO COUNTY

NAME OF UTILITY	SOURCE	STORAGE/TRANSMISSION	TREATMENT
California Water Service			
Broadmoor District	SFWD	San Andreas	No further treatment
Bear Gulch	SFWD and local runoff	Bear Gulch Reservoir Hetch Hetchy Pipeline	Chlorine-ammonia, alum and filtration
San Carlos	SFWD	Hetch Hetchy Pipeline	No further treatment
San Mateo	SFWD	Crystal Springs	No further treatment
S. S.F.	SFWD and local wells	Crystal Springs and San Andreas	Chlorination
Daly City Municipal Water Utility	SFWD and local wells	Crystal Springs and San Andreas	Chlorination
Coastside Water District	SFWD and local wells	Pilarcitos Reservoir	Chlorination
Belmont Water District	SFWD	Hetch Hetchy Pipeline	No further treatment
City of Brisbane	SFWD	Crystal Springs	No further treatment
City of Burlingame	SFWD	Crystal Springs	No further treatment
Dimond Public Utilities District	SFWD	Crystal Springs	No further treatment
Hillsborough Water Dept.	SFWD	Crystal Springs	No further treatment
Menlo Park Municipal Water Department	SFWD	Hetch Hetchy Pipeline	No further treatment
City of Millbrae	SFWD	Crystal Springs and San Andreas	No further treatment
Estero Municipal Improvement District	SFWD	Crystal Springs	No further treatment

TABLE 3 (continued)

NAME OF UTILITY	SOURCE	STORAGE/TRANSMISSION	TREATMENT
Redwood City Water Dept.	SFWD	Hetch Hetchy Pipeline	No further treatment
City of San Bruno	SFWD and local wells	San Andreas	Chlorination
E. Palo Alto Waterworks	SFWD	Hetch Hetchy Pipeline	No further treatment
North Coast County Water District	SFWD	San Andreas	No further treatment
Westborough County Water District	SFWD	San Andreas	No further treatment

TABLE 4. WATER SUPPLY FOR SAN MATEO COUNTY BY CENSUS TRACT

TRACT	LOCATION	SUPPLIER	SOURCE *	PAST SOURCE *	SAMPLE DATE	ASBESTOS X 10^6/L
6001	S. Br. Mt	City of Brisbane	1	3	7/77,12/77	0.2,0.15
6002	Daly City	Dimond PUD	1	3		
6003	Daly City	Daly City	1,2,5	3,4,5		
6004	Daly City	Daly City	1,2,5	3,4,5		
6005	Daly City	Daly City	1,2,5	3,4,5		
6006	Daly City	Daly City	1,2,5	3,4,5		
6007	Daly City	Daly City	1,2,5	3,4,5		
6008	Daly City	Daly City	1,2,5	3,4,5		
6009	Daly City	Daly City	1,2,5	3,4,5		
6010	Daly City	Daly City	1,2,5	3,4,5		
6011	Daly City	Daly City	1,2,5	3,4,5		
6012	Daly City	CWS, Broadmoor & D.C.	1,2,5	3,4,5	7/77	0.12
6013	Daly City	CWS, Broadmoor & D.C.	1,2,5	3,4,5		
6014	Daly City	Daly City	1,2,5	3,4,5		
6015	Daly City	Daly City	1,2,5	3,4,5		
6016	Daly City	Daly City	1,2,5	3,4,5		
6017	S. SF	CWS, S. SF	1,2	3,4,5		
6018	S. SF	CWS, S. SF	1,2	3,4		
6019	S. SF	CWS, S. SF	1,2,5	3,4,5		
6020	S. SF	CWS, S. SF	1,2	3,4		
6021	S. SF	CWS, S. SF	1,2	3,4		
6022	S. SF	CWS, S. SF	1,2	3,4		
6023	S. SF	CWS, S. SF	1,2	3,4		
6024	S. SF	CWS, S. SF	1,2	3,4		
6025	S. SF	Westborough W.D.	2	4	7/77	0.15
6026	Pacifica	Westborough W.D.	2	4	7/77	0.4,0.2,0.3
6027	Pacifica	N. Coast Co.	2	4		
6028	Pacifica	N. Coast Co.	2	4		
6029	Pacifica	N. Coast Co.	2	4	7/77	0.75
6030	Pacifica	N. Coast Co.	2	4	7/77	0.35
6031	Pacifica	N. Coast Co.	2	4		
6032	Pacifica	N. Coast Co,	2	4		
6033	Pacifica	N. Coast Co.	2	4	7/77	0.38
6034	Pacifica	N. Coast Co.	2	4		
6035	SF Co. Jail					
6036	San Bruno	San Bruno	6	6		
6037	San Bruno	San Bruno	2,6	4,6	12/76,5/77	0.68,0.6
6038	San Bruno	San Bruno	2,6	4,6		
6039	San Bruno	San Bruno	5	5		

TABLE 4 (continued)

TRACT	LOCATION	SUPPLIER	SOURCE*	PAST SOURCE*	SAMPLE DATE	ASBESTOS X 10^6/L
6040	San Bruno	San Bruno	5	5		
6041	San Bruno	San Bruno	5	5	5/77	BDL, BDL
6042	San Bruno	San Bruno	5	5		
6043	SF Airport					
6044	Millbrae	Millbrae MWD	1	3	12/76,5/77,8/77, 11/78	0.2,22,23, 43
6045	Millbrae	Millbrae MWD	2	4		
6046	Millbrae	Millbrae MWD	2	4		
6047	Millbrae	Millbrae MWD	2	4		
6048	Millbrae	Millbrae MWD	1,2	3,4	12/76,12/76, 5/77,5/77	1.7,0.24, 11,32
6049	Millbrae	Millbrae MWD	1,2	3,4		
6050	Burlingame	City of Burlingame	1	3		
6051	Burlingame	City of Burlingame	1	3	5/77	14
6052	Burlingame	City of Burlingame	1	3		
6053	Burlingame	City of Burlingame	1	3		
6054	Burlingame	City of Burlingame	1	3	5/77	20
6055	Burlingame	City of Burlingame	1	3	7/74,5/77,7/77	BDL,15,44
6056	Hillsborough	City of Hillsborough	1	3		
6057	Hillsborough	City of Hillsborough	1	3	7/77	20
6058	San Mateo	CWS, San Mateo	1	3		
6059	San Mateo	CWS, San Mateo	1	3		
6060	San Mateo	CWS, San Mateo	1	3		
6061	San Mateo	CWS, San Mateo	1	3	7/77	31
6062	San Mateo	CWS, San Mateo	1	3		
6063	San Mateo	CWS, San Mateo	1	3		
6064	San Mateo	CWS, San Mateo	1	3		
6065	San Mateo	CWS, San Mateo	1	3	5/77	16
6066	San Mateo	CWS, San Mateo	1	3		
6067	San Mateo	CWS, San Mateo	1	3		
6068	San Mateo	CWS, San Mateo	1	3		
6069	San Mateo	CWS, San Mateo	1	3		
6070	San Mateo	CWS, San Mateo	1	3		
6071	San Mateo	CWS, San Mateo	1	3		
6072	San Mateo	CWS, San Mateo	1	3	7/77	50
6073	San Mateo	CWS, San Mateo	1	3		
6074	San Mateo	CWS, San Mateo	1	3		
6075	San Mateo	CWS, San Mateo	1	3		
6076	San Mateo	CWS, San Mateo	1	3		

TABLE 4 (continued)

TRACT	LOCATION	SUPPLIER	SOURCE*	PAST SOURCE*	SAMPLE DATE	ASBESTOS X 10^6/L
6077	San Mateo	CWS, San Mateo	1	3		
6078	San Mateo	CWS, San Mateo	1	3		
6079	San Mateo	Estero Mun. Dist.	1	3		
6080	Foster City	Estero Mun, Dist.	1	3	12/76,7/77	1.1,6.0
6081	Foster City	Estero Mun. Dist.	1	3	12/76,7/77	0.067,43
6082	Foster City	Estero Mun. Dist.	1	3		
6083	Foster City	Estero Mun. Dist.	1	3		
6084	San Mateo	CWS, San Mateo	1	3		
6085	San Mateo	CWS, San Mateo	1	3		
6086	Belmont	Belmont W.D.	1,6	3,6		
6087	Belmont	Belmont W.D.	1,6	3,6	7/77	BDL
6088	Belmont	Belmont W.D.	1,6	3,6	7/77	0.05
6089	Belmont	Belmont W.D.	1,6	3,6	7/77,7/77	BDL,0.05
6090	Belmont	Belmont W.D.	1,6	3,6	7/77,12/77	6.4,19,0.77
6091	San Carlos	CWS, San Carlos	6	6	7/77	0.04
6092	San Carlos	CWS, San Carlos	6	6	7/77,12/77	6,12
6093	San Carlos	CWS, San Carlos	6	6		
6094	San Carlos	CWS, San Carlos	6	6		
6095	San Carlos	CWS, San Carlos	6	6		
6096	San Carlos	CWS, San Carlos	6	6		
6097	Redwood City	Redwood City	6	6		
6098	Redwood City	Redwood City	6	6		
6099	Redwood City	Redwood City	6	6		
6100	Redwood City	Redwood City	6	6	12/76	0.04
6101	Redwood City	Redwood City	6	6		
6102	Redwood City	Redwood City	6	6	7/74,12/76,7/77	BDL,0.04,1.6
6103	Redwood City	Redwood City	6	6		
6104	Redwood City	Redwood City	6	6		
6105	Redwood City	CWS, Bear Gulch	6	6		
6106	Redwood City	CWS, Bear Gulch	6	6		
6107	Redwood City	CWS, Bear Gulch	6	6		
6108	Redwood City	CWS, Bear Gulch	6	66		
6109	Redwood City	Redwood City	6	6		
6110	Redwood City	Redwood City	6	6		
6111	Redwood City	Redwood City	6	6	7/77	BDL
6112	Redwood City	Redwood City	6	6	12/76	BDL
6113	Woodside	CWS, Bear Gulch	6	6		
6114	Atherton	CWS, Bear Gulch	6	6		
6115	Atherton	CWS, Bear Gulch	6	6	12/76,7/77	0.55,0.025

TABLE 4 (continued)

TRACT	LOCATION	SUPPLIER	SOURCE*	PAST SOURCE*	SAMPLE DATE	ASBESTOS X 10^6/L
6116	Menlo Park	CWS, BG, and Menlo Park	6	6		
6117	Menlo Park	CWS, BG, and Menlo Park	6	6		
6118	Menlo Park	E. Palo Alto WD	6	6		
6119	E. Palo Alto	E. Palo Alto WD	6	6		
6120	E. Palo Alto	E. Palo Alto WD	6,5	6,5		
6121	E. Palo Alto	E. Palo Alto WD	5,6	5,6	7/77	1.4
6122	Menlo Park	Menlo Park & CWS, BG	6	6	7/77	20
6123	Menlo Park	Menlo Park	6	6	7/77	BDL
6124	Menlo Park	Menlo Park, CWS, BG	6	6		
6125	Menlo Park	CWS, Bear Gulch	6	6		
6126	Menlo Park	CWS, Bear Gulch	6	6		
6127	Menlo Park	CWS, Bear Gulch	6	6		
6128	Menlo Park	CWS, Bear Gulch	6	6		
6129	Menlo Park	CWS, Bear Gulch	6	6	12/76,12/76	0.6,0.8,
6130	Menlo Park	Menlo Park & CWS, BG			7/77,7/77	0.15,0.075
6131	Menlo Park	CWS, Bear Gulch	6	6		
6132	Portola Valley	CWS, Bear Gulch	6	6		
6133	Woodside	CWS, Bear Gulch	6	6		
6134	Woodside	CWS, Bear Gulch	6	6		
6135	Crystal Springs	Coastside	7	7		
6136	Montara	Citizens Utility	5,7	5,7		
6137	Half Moon Bay	Coastside	5,7	5,7		
6138	unincorporated	Coastside & Skyline	7	7		

*: 1 - Bypass Tunnel, 2 - San Andreas treatment plant, 3 - Crystal Springs, 4 - San Andreas, 5 - local wells, 6 - Hetch Hetchy pipeline, 7 - local runoff

SECTION 3

MARIN COUNTY

Drinking water for Marin County is supplied almost exclusively from local runoff, with some importation of Russian River water during periods of extremely low rainfall. The two major utilities currently serving the county are Marin Municipal Water District and North Marin County Water District.

North Marin County Water District

The North Marin County Water District serves the community of Novato and the northern portion of the county which is not heavily populated. Until 1951 the area was primarily agricultural, and groundwater was the sole source of supply. In 1948, the Novato Water Company was formed to develop the water supply in the area. Stafford Lake and treatment plant were constructed for entrapment and treatment of local runoff. Treatment involves aeration, pre-chlorination, coagulation, activated carbon, filtration, dechlorination with sulfur hydroxide, and caustic soda. Completion of the Russian River Project in the 1970's permitted the district to import water form the Russian River during the dry season. Russian River water is delivered via aqueduct from Petaluma into Novato, where it is chlorinated before distribution.

Marin Municipal Water District

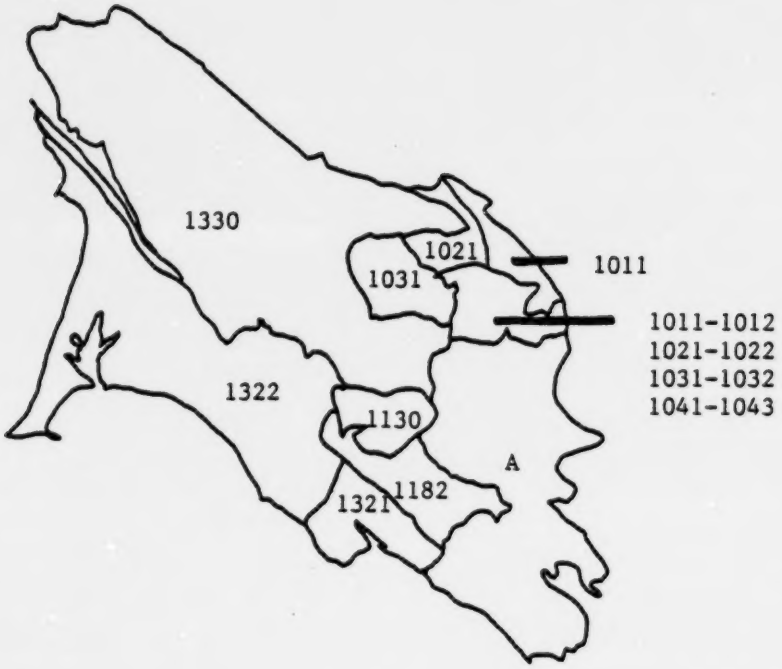
The remainder of Marin County, which includes the more heavily populated areas of the county, is served by the Marin Municipal Water District (MMWD). The district was formed in 1916 by the purchase of two major private water companies with the passage of a bond issue. The Tamalpais watershed served as the local source and water was stored in Alpine, Lagunitas, and Phoenix Lakes.

Prior to the formation of the district, the area was served mainly by Marin Power and Water Company, and North Coast Water Company. In addition, there were

numerous small districts operating throughout the area which were subsidiaries of real estate companies serving the tracts being subdivided, and the distribution system was installed by sixteen separate and independent companies. The Marin Water and Power Company served the area of San Rafael and south to Sausalito, its water supply being Lake Lagunitas and Phoenix Gulch Lake, both on the north slope of Mt. Tamalpais. North Coast Water Company supplied Mill Valley and east to Belvedere and Tiburon with water from a series of springs flowing on the south slope of Mt. Tamalpais.

The district is sub-divided into four major geographical distribution systems. The northern portion is supplied mainly by the Alpine system, and by water pumped from Kent Lake. The north central area, around San Rafael, is served mainly by the Alpine system with a small amount from Ross Reservoir, in addition to lines from Kent Lake. The central area is supplied through Ross Reservoir (mainly Alpine system) with some water supplied by Bon Tempe Lake. The southern district receives most of its water from Bon Tempe Reservoir. Prior to the construction of the pipeline from Bon Tempe, Ross Reservoir was the major source of water for this district.

Following the construction of Nicasio Dam in 1960 and the treatment plants at San Geronimo in 1961 and Bon Tempe in 1959, water from Bon Tempe and Alpine Lakes was treated at Bon Tempe treatment plant prior to distribution. The treatment plant in San Geronimo Valley treats water from Kent Lake and Nicasio. Treatment at both plants involves pre- and post-chlorination, coagulation, activated carbon, filtration, and lime.



TRACT	UTILITY	SOURCE
1330	North Marin Co. Water District	local runoff and Russian River
1011-1012 1021-1022 1031-1032 1041-1042	North Marin Co. Water District	local runoff and Russian River
1322	North Marin and Citizens Utility	local runoff and Russian River, wells
1321	Stinson Beach and Bolinas County	wells
1130	Marin Municipal Water District	San Geronimo Treatment Plant
1182	Marin Municipal Water District	Bon Tempe Treatment Plant
A	Marin Municipal Water District	See Figure 7

Figure 6. Marin County Water Sources and Suppliers

San Geronimo Treatment Plant:

No. Samples	Tract No.
1	1102
2	1211
1	1170

Bon Tempe Treatment Plant:

No. Samples	Tract No.
4	1261

Mixture of San Geronimo and Bon Tempe:

No. Samples	Tract No.
1	1212
1	1302

Figure 7. Detailed map showing census tracts previously sampled for asbestos in MMWD

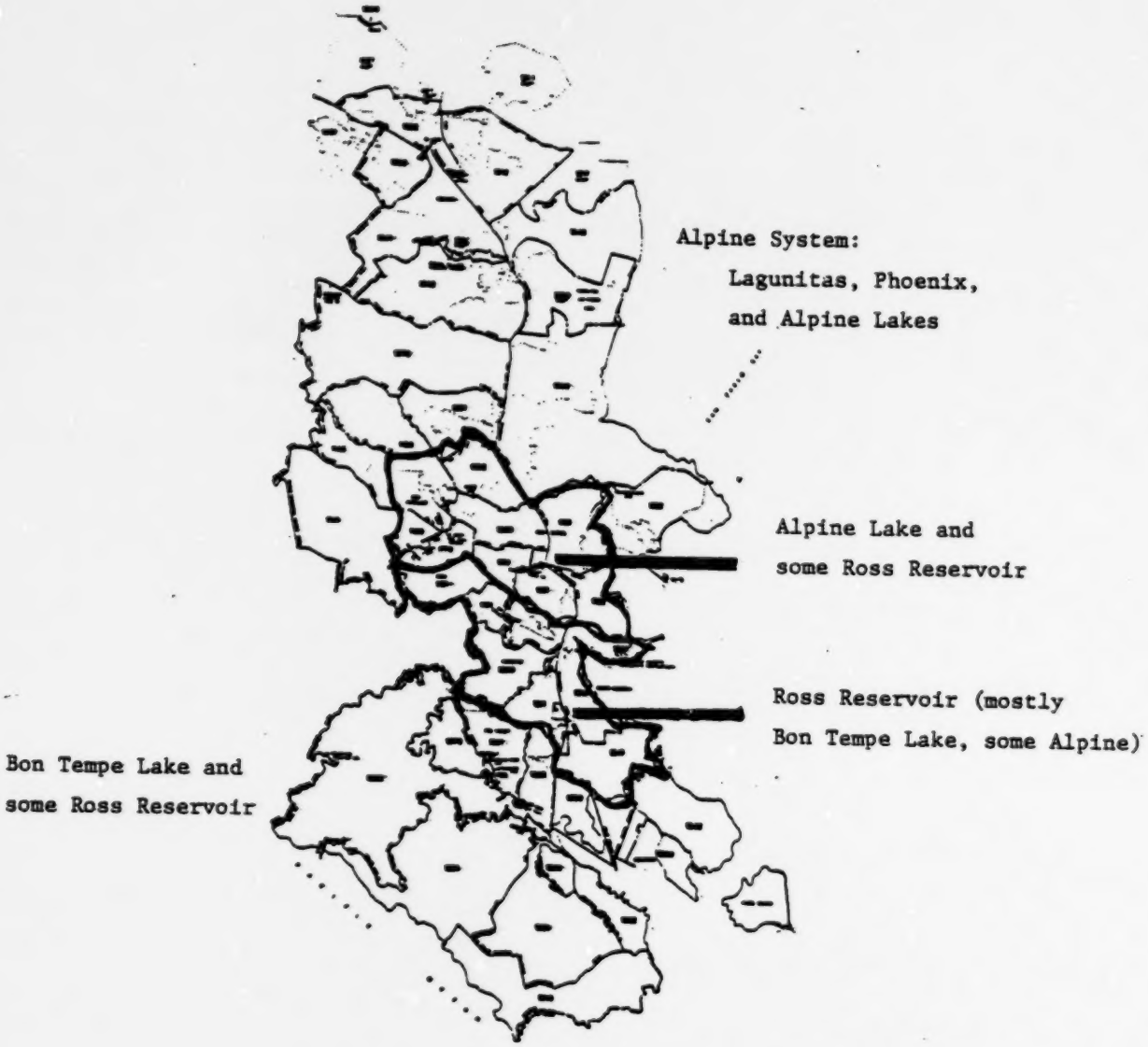


Figure 8. Historical water source for part of Marin County

TABLE 5. HISTORICAL WATER SUPPLY - MARIN COUNTY

NAME OF UTILITY	DATE	SOURCE	STORAGE/TRANSMISSION	TREATMENT
Marin Municipal Water District	1916	local runoff	Alpine, Lagunitas, and Phoenix Lakes	
	1948	local runoff	Bon Tempe Lake completed	
	1953	local runoff	Kent Lake completed	
	1959	Bon Tempe and Alpine Lakes	Bon Tempe Treatment Plant	Chlorination, coagulation, carbon, filtration, and lime
	1960	local runoff	Nicasio Dam completed	
	1962	Kent Lake and Nicasio Reservoirs	San Geronimo Treatment Plant	"
Novato Water Co.	1948	groundwater		
North Marin Co. Water District formed	1960	local runoff	Stafford Lake and Treatment Plant	Aeration, chlorination, coagulation, carbon, filtration, dechlorination, and lime
	1970	local runoff and Russian River water (Sonoma Co. Flood Control and Water District)	Stafford Lake and Treatment Plant	Chlorination of Russian River water

TABLE 6. WATER SUPPLY FOR MARIN COUNTY BY CENSUS TRACT

TRACT	LOCATION	SUPPLIER†	SOURCE§	PAST SOURCE	SAMPLE DATE	ASBESTOS X 10^6/L
1011	Novato	NMCWD	Russian R., runoff	Runoff		
1012	Novato	NMCWD	Russian R., runoff	Runoff		
1021	Novato	NMCWD	Russian R., runoff	Runoff		
1022	Novato	NMCWD	Russian R., runoff	Runoff		
1031	Novato	NMCWD	Russian R., runoff	Runoff		
1032	Novato	NMCWD	Russian R., runoff	Runoff		
1041	Novato	NMCWD	Russian R., runoff	Runoff		
1042	Novato	NMCWD	Russian R., runoff	Runoff		
1043	Novato	NMCWD	Russian R., runoff	Runoff		
1050	HAFB	NMCWD & MMWD	Russ. R., runoff, S.G.	Runoff & Alpine		
1060	S. Venetia	MMWD	S.G.	Alpine System		
1070	Lucas Valley	MMWD	S.G.	Alpine		
1081	Lucas Valley	MMWD	S.G.	Alpine		
1082	S. Rafael	MMWD	S.G.	Alpine & Ross		
1090	S. Rafael	MMWD	S.G.	Alpine & Ross		
1101	S. Rafael	MMWD	S.G.	Alpine & Ross		
1102	S. Rafael	MMWD	S.G.	Alpine & Ross	3/75	0.9
1110	S. Rafael	MMWD	S.G.	Alpine & Ross		
1121	S. Rafael	MMWD	S.G.	Alpine & Ross		
1122	S. Rafael	MMWD	S.G.	Alpine & Ross		
1130	S. Geron. Valley	MMWD	S.G.	Alpine	8/77,1/78	0.7, 11
1141	S. Geron. Valley	MMWD	S.G.	Alpine		
1142	S. Anselmo	MMWD	S.G.	Alpine		
1150	S. Anselmo	MMWD	S.G.	Alpine & Ross		
1160	S. Anselmo	MMWD	S.G.	Alpine & Ross		
1170	Ross	MMWD	S.G. & B.T.	Alpine & Ross	11/76	BDL
1181	Kentfield	MMWD	S.G.	Ross		
1182	Larkspur	MMWD	B.T.	Ross	11/76,8/77	0.02, BDL
1191	Larkspur	MMWD	S.G. & B.T.	Ross		
1192	Larkspur	MMWD	S.G.	Ross		
1200	Corte Madera	MMWD	S.G. & B.T.	Ross		
1211	Corte Madera	MMWD	S.G.	Ross	11/76, 12/76	0.04, 0.16
1212	S. Quentin	MMWD	S.G. & B.T.	Ross	11/76	0.04
1220	Belvedere	MMWD	S.G. & B.T.	Ross		
1230	Tiburon	MMWD	S.G. & B.T.	Bon Tempe L. & Ross		
1241	Tiburon	MMWD	S.G. & B.T.	Bon Tempe L. & Ross		
1242	Strawberry	MMWD	S.G. & B.T.	Bon Tempe L. & Ross		
1250			S.G. & B.T.	Bon Tempe L.		

TABLE 6 (continued)

TRACT	LOCATION	SUPPLIER†	SOURCE§	PAST SOURCE	SAMPLE DATA	ASBESTOS X 10^6/L
1261	Mill Valley	MMWD	B.T.	Bon Tempe L. and Ross	11/76, 11/76 12/76, 8/77	0.04, BDL BDL, 0.1
1262	Mill Valley	MMWD	B.T.	Bon Tempe L. and Ross		
1270	Mill Valley	MMWD	B.T	Bon Tempe L. and Ross		
1281	GGNR	MMWD	B.T. & S.G.	Bon Tempe L.		
1282	Mt. Tam Park	MMWD	B.T.	Bon Tempe L. and Ross		
1290	Marin City	MMWD	B.T. & S.G.	Bon Tempe L. and Ross		
1301	GGNR	MMWD	B.T. & S.G.	Bon Tempe L.		
1302	Sausalito	MMWD	B.T. & S.G.	Bon Tempe L. and Ross	11/76	0.02
1310	Ft. Barry	MMWD	B.T. & S.G.	Bon Tempe L.		
1321	GGNR	?	wells			
1322	Point Reyes	NMCWD	wells	wells		
1330	unincorporated	NMCWD	runoff	runoff		

†: NMCWD - North Marin County Water District
MMWD - Marin Municipal Water District

§: S.G. - San Geronimo treatment plant (1962)
B.T. - Bon Tempe treatment plant (1950)

SECTION 4

ALAMEDA COUNTY

The two major purveyors of water in Alameda County are the East Bay Municipal Utilities District (EBMUD) and the Alameda County Flood Control and Water District (ACFCWD). In addition, the San Francisco Water Department supplies water from its Alameda division to Sunol, Lawrence Livermore Laboratory, and various private industries, and directs Hetch Hetchy water to Hayward. The Alameda County Water District, Fremont, purchases water from San Francisco and ACFCWD.

East Bay Municipal Utilities District

The EBMUD was formed in 1923 to bring imported water into parts of Alameda and Contra Costa Counties. The source of water for this area was surface runoff from San Leandro, San Pablo, Wildcat, and Temescal Creeks, augmented by local wells. Reservoirs for impounding the surface water consisted of Upper San Leandro, Lake Chabot, San Pablo, and Temescal. When a period of low rainfall created a major shortage in the local water supplies, the Mokelumne Project to import mountain water into the area was developed and completed in 1929. Pardee Dam, constructed in 1924, and Camanche Reservoir, 1964, impounds the mountain water which is then delivered by aqueduct to five terminal reservoirs in the district. These reservoirs, Upper San Leandro, Briones, Chabot, San Pablo, and Lafayette also impound local runoff. Five rapid sand filter plants treat the water before distribution. Water directly from the Mokelumne via Pardee Reservoir is filtered and chlorinated at the Orinda and Lafayette plants, whereas the San Pablo, Upper San Leandro, and Chabot plants use alum, lime, pre- and post-chlorination, and filtration before distribution.

As the service area of the EBMUD increased, more water was imported from the Sierra mountains to meet the demand, and two new treatment plants were con-

structed. Beginning in 1964 water from San Pablo Reservoir was treated at the Sobrante plant, and in 1967 the Walnut Creek plant began receiving and treating water directly from Pardee Reservoir. Some of the Mokelumne water goes directly to the treatment plants at Orinda, Lafayette, and Walnut Creek, which use filtration, chlorination, and some lime addition. Water is also pumped from the aqueduct to Lafayette Reservoir, which is then pumped to Upper San Leandro and treated. Water from San Pablo Reservoir goes to the Sobrante and San Pablo treatment plants. The San Leandro, San Pablo, and Sobrante plants use aeration, coagulation, sedimentation, filtration, chlorination, and pH control.

Alameda County Flood Control and Water District

The Alameda County Flood Control and Water District (ACFCWD) was established by the State Legislature in 1949 as a means to solve flooding, drainage, water supply, and water conservation problems. The District is divided into ten zones, Zone 7 including Livermore, Pleasnaton, Dublin, Sunol, Altamont, and small portions of Fremont, Hayward, and Union City. The District is the principal water wholesaler for the Livermore and Amador Valley area, and has contracts with the cities of Livermore and Pleasanton, Valley Community Services District, and California Water Services Company. It controls and sets quotas for well pumping to prevent the overdraft of local groundwater, and is also responsible for treatment and wholesale distribution into the basin.

Up until 1960, local well systems were sufficient for supplying the water needs of the Valley, however, the 1960's brought a need for importing water and wholesale distribution. In 1961, the ACFCWD contracted for water from the South Bay aqueduct, a U.S. Bureau of Reclamation project which pumps water from the San Joaquin delta area. A treatment plant near Patterson Reservoir treats the water for municipal use. The Mocho and Hopyard wellfields are also operated by

Zone 7, and deliver water via pipeline into Pleasanton and the Valley Community Services District areas. Treatment at the Patterson plant consists of pre- and post-chlorination, coagulation, filtration, and lime treatment; well water is chlorinated prior to distribution.

The City of Livermore operates no wells or treatment facilities. The city is served mostly by the California Water Services Company which delivers well water and treated South Bay aqueduct water. The remainder of the city is serviced by Zone 7 water contracted directly from the ACFCWD.

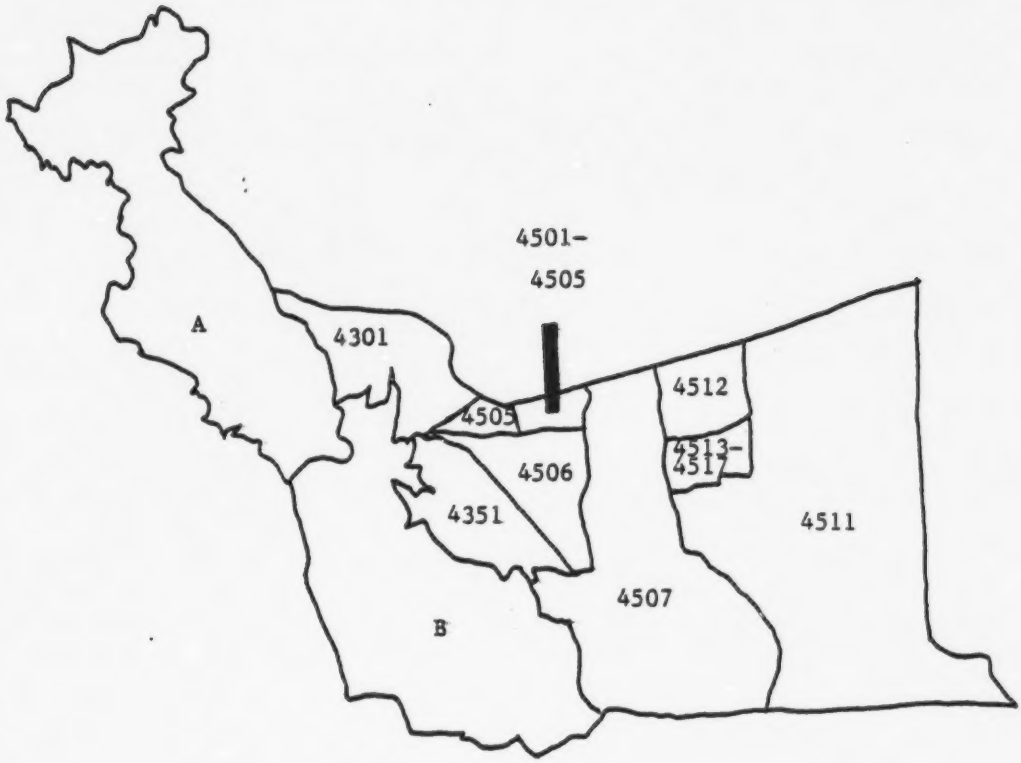
The City of Pleasanton Water Department is publicly owned. It operates five wells of its own, in addition to purchasing water from Zone 7 well fields. Beginning in 1975, South Bay water, treated at Del Valle treatment plant, was blended with Zone 7 well water for use by the City of Pleasanton. At various times in the past it has purchased water from the San Francisco Water Department.

The Valley Community Services District is a privately owned utility serving the Dublin-San Ramon area of the county. It operates two wells, and in 1971 was purchasing 70% of its water from ACFCWD and supplying the rest form its own wells. In 1975, it was supplying treated South Bay water from Del Valle, blended with Zone 7 well water.

Alameda County Water District, Fremont

The Alameda County Water District (ACWD) serves the Fremont area, incorporated in 1956. At that time, water was supplied by the ACWD, Citizins Utility of California, and private wells. Increased pumping of groundwater from the Alameda Creek watershed resulted in salt water intrusion of local groundwater basins and a need for importing water. The ACWD currently purchases Hetch Hetchy water from San Francisco, and South Bay water, treated at the Mission San Jose treatment plant, from ACFCWD. The remainder of the water is supplied

by local wells. Treatment at the San Jose plant involves coagulation, filtration, and chlorination. Local well water is treated by ion exchange and softening agents before distribution, while water purchased from San Francisco is not treated further.



TRACT	UTILITY	SOURCE
A	EBMUD	See Figure 10
B	EBMUD and others	See Figure 10
4301, 4351	EBMUD	
4503-4505	Valley Community	South Bay and wells
4506-4507	City of Pleasanton	South Bay and wells
4511	CWS, Livermore	South Bay and wells
4512	City of Livermore	South Bay and wells
4513-4517	CWS, Livermore & City of Livermore	South Bay and wells

Figure 9. Alameda County water suppliers and water source

Inset B

CITY OF HAYWARD:

	No. Samples	No. Tracts
Hetch Hetchy (SFWD)	6	6

ALAMEDA COUNTY WATER DISTRICT:

	No. Samples	No. Tracts
Hetch Hetchy	2	2
Wells	4	3
S. Bay Aqueduct	1	1

Inset A

EBMUD:

Treatment Plant	No. Samples	No. Tracts
Orinda	18	10
Orinda & S. Leandro	8	3
Orinda & S. Pablo	8	4

Figure 10. Detailed census tract maps depicting areas of previous asbestos sampling

TABLE 7. HISTORICAL WATER SUPPLY - ALAMEDA COUNTY

NAME OF UTILITY	DATE	SOURCE	STORAGE/TRANSMISSION	TREATMENT
East Bay Municipal Utilities District (EBMUD)	1923	Surface runoff and local wells	Lake Chabot, San Leandro, San Pablo and Temescal Reservoirs, San Pablo Treatment Plant	Alum, lime, and filtration
	1929	Mokelumne River (imported from Sierra Nevada mountains), local watershed	Pardee Reservoir and 5 terminal reservoirs	
	1949	Local watershed and Mokelumne River	Orinda Treatment Plant, San Pablo, San Leandro, Chabot, Briones, and Lafayette Reservoirs	Chlorination, filtration, and lime
	1964	San Pablo Reservoir	Sobrante Treatment Plant	aeration, coagulation, sedimentation, filtration, and chlorination
	1960	Mokelumne River	Lafayette Filter Plant	Chlorination, filtration, and lime
	1967	Mokelumne River	Walnut Creek Treatment Plant	Chlorination, filtration, and lime
Alameda County Flood Control and Water District (ACFCWD)	1949	Mocho and Hopyard Wellfields		Chlorination
	1961	South Bay Aqueduct (San Joaquin delta), and local wells	Patterson Reservoir and Treatment Plant	Chlorination, coagulation, filtration, and lime
	1975	South Bay Aqueduct and local wells	Patterson and Del Valle Reservoirs and Treatment Plants	Chlorination, coagulation, filtration, and caustic soda

TABLE 7 (continued)

NAME OF UTILITY	DATE	SOURCE	STORAGE/TRANSMISSION	TREATMENT
Valley Community Services District (VCSD)		Local well water		Filtration, chlorination, and sodium phosphate
	1949	Local well water and Zone 7 well water from ACFCWD		No further treatment to purchased water
Dublin-San Ramon Community Services District (formerly VCSD)	1975	Local well water and a blend of Zone 7 well water and South Bay water	Del Valle Reservoir and Treatment Plant	No further treatment to purchased water
California Water Service Co., Livermore		Local well water		
	1949	Local well water and well water from ACFCWD		
	1961	Local well water and South Bay water from ACFCWD	Patterson Treatment Plant	
City of Pleasanton		Local well water		Chlorination
	1949	Local well water and well water from ACFCWD		Chlorination of local well water
	1975	Local well water and South Bay water blended with well water from ACFCWD	Del Valle Reservoir and Treatment Plant	No further treatment of purchased water

TABLE 7 (continued)

NAME OF UTILITY	DATE	SOURCE	STORAGE/TRANSMISSION	TREATMENT
City of Hayward		Local wells, Alameda watershed, and Sunol Galleries		
	1950	Local well water blended with water purchased from SFWD	Alameda Pipeline	No further treatment to purchased water
	1965	Water purchased from SFWD	Alameda Pipeline and Bay Division Hetch Hetchy Pipeline; Sunol Valley Treatment Plant	No further treatment to purchased water
Citizens' Utility		Local wells		Ion exchange and softening
Alameda County Water District, Fremont	1956	Water purchased from SFWD and local well water	Bay Division Hetch Hetchy Pipeline	
	1975	Local wells and water purchased from SFWD and ACFCWD	Bay Division Hetch Hetchy and Mission San Jose Treatment Plant	Chlorination, filtration, and coagulation

TABLE 8. WATER SUPPLY FOR ALAMEDA COUNTY BY CENSUS TRACT

TRACT	LOCATION	SUPPLIER †	SOURCE §	PAST SOURCE	SAMPLE DATE	ASBESTOS X 10^6/L
4001	Oakland	EBMUD	1(49)	2		
4002	Oakland	EBMUD	1,2(49)	2		
4003	Oakland	EBMUD	1(49)	2		
4004	Oakland	EBMUD	1,2(49)	2		
4005	Oakland	EBMUD	1,2(49)	2		
4006	Oakland	EBMUD	1,2(49)	2		
4007	Oadland	EBMUD	1,2(49)	2		
4008	Oakland	EBMUD	1,2(49)	2		
4009	Oakland	EBMUD	1,2(49)	2		
4010	Oakland	EBMUD	1,2(49)	2		
4011	Oalland	EBMUD	1(49)	2		
4012	Oakland	EBMUD	1(49)	2		
4013	Oakland	EBMUD	1(49)	2		
4014	Oakland	EBMUD	1(49)	2		
4015	Oakland	EBMUD	1,2(49)	2		
4016	Oakland	EBMUD	1,2(49)	2		
4017	Oakland	EBMUD	1,2(49)	2		
4018	Oakland	EBMUD	1,2(49)	2		
4019	Oakland	EBMUD	1,2(49)	2		
4020	Oakland	EBMUD	1(49)	2		
4021	Oakland	EBMUD	1(49)	2		
4022	Oakland	EBMUD	1(49)	2		
4023	Oakland	EBMUD	1(49)	2	6/77	0.2
4024	Oakland	EBMUD	1(49)	2		
4025	Oakland	EBMUD	1(49)	2		
4026	Oakland	EBMUD	1(49)	2		
4027	Oakland	EBMUD	1(49)	2		
4028	Oakland	EBMUD	1(49)	2		
4029	Oakland	EBMUD	1(49)	2		
4030	Oakland	EBMUD	1(49)	2		
4031	Oakland	EBMUD	1(49)	2		
4032	Oadland	EBMUD	1(49)	2		
4033	Oakland	EBMUD	1(49)	2		
4034	Oakland	EBMUD	1(49)	2		
4035	Oakland	EBMUD	1(49)	2		

TABLE 8 (continued)

TRACT	LOCATION	SUPPLIER†	SOURCE§	PAST SOURCE	SAMPLE DATE	ASBESTOS X 10^6/L
4036	Oakland	EBMUD	1(49)	2		
4037	Oakland	EBMUD	1(49)	2		
4038	Oakland	EBMUD	1(49)	2		
4039	Oakland	EBMUD	1(49)	2		
4041	Oakland	EBMUD	1(49)	2	6/77	0.2
4042	Oakland	EBMUD	1(49)	2		
4043	Oakland	EBMUD	1(49)	2		
4044	Oakland	EBMUD	1(49)	2		
4045	Oakland	EBMUD	1(49)	2		
4046	Oakland	EBMUD	1(49)	2	7/77	0.15, BDL
4047	Oakland	EBMUD	1(49)	2		
4048	Oakland	EBMUD	1(49)	2		
4049	Oakland	EBMUD	1(49)	2		
4050	Oakland	EBMUD	1(49)	2		
4051	Oakland	EBMUD	1(49)	2		
4052	Oakland	EBMUD	1(49)	2		
4053	Oakland	EBMUD	1(49)	2		
4054	Oakland	EBMUD	1(49)	2	6/77	0.9
4055	Oakland	EBMUD	1(49)	2		
4056	Oakland	EBMUD	1(49)	2		
4057	Oakland	EBMUD	1(49)	2		
4058	Oakland	EBMUD	1(49)	2		
4059	Oakland	EBMUD	1(49)	2		
4060	Oakland	EBMUD	1(49)	2		
4061	Oakland	EBMUD	1,3(49)	3		
4062	Oakland	EBMUD	1(49)	2		
4063	Oakland	EBMUD	1(49)	2		
4064	Oakland	EBMUD	1(49)	2		
4065	Oakland	EBMUD	1(49)	2	7/74,9/76,6/77	BDL,0.15,0.3
4066	Oakland	EBMUD	1(49)	2	7/74,9/76,6/77	BDL,0.2,0.1
4067	Oakland	EBMUD	1(49)	2		
4068	Oakland	EBMUD	1(49)	2		
4069	Oakland	EBMUD	1(49)	2		
4070	Oakland	EBMUD	1,3(49)	3		
4071	Oakland	EBMUD	1,3(49)	3	6/77	0.6
4072	Oakland	EBMUD	1,3(49)	3		
4073	Oakland	EBMUD	1,3(49)	3		
4074	Oakland	EBMUD	3,1(49)	3		

TABLE 8 (continued)

TRACT	LOCATION	SUPPLIER†	SOURCE§	PAST SOURCE	SAMPLE DATE	ASBESTOS X 10^6/L
4075	Oakland	EBMUD	3,1(49)	3		
4076	Oakland	EBMUD	3,1(49)	3		
4077	Oakland	EBMUD	3,1(49)	3		
4078	Oakland	EBMUD	3,1(49)	3		
4079	Oakland	EBMUD	1(49)	3		
4080	Oakland	EBMUD	1(49)	3		
4081	Oakland	EBMUD	1,3(49)	3		
4082	Oakland	EBMUD	3,1(49)	3		
4083	Oakland	EBMUD	3,1(49)	3		
4084	Oakland	EBMUD	3,1(49)	3		
4085	Oakland	EBMUD	3,1(49)	3		
4086	Oakland	EBMUD	3,1(49)	3		
4087	Oakland	EBMUD	3,1(49)	3		
4088	Oakland	EBMUD	3,1(49)	3		
4089	Oakland	EBMUD	3,1(49)	3		
4090	Oakland	EBMUD	3,1(49)	3	6/77	0.5
4091	Oakland	EBMUD	3,1(49)	3		
4092	Oakland	EBMUD	3,1(49)	3		
4093	Oakland	EBMUD	3,1(49)	3		
4094	Oakland	EBMUD	3,1(49)	3		
4095	Oakland	EBMUD	3,1(49)			
4096	Oakland	EBMUD	3,1(49)	3		
4097	Oakland	EBMUD	3,1(49)	3		
4098	Oakland	EBMUD	3,1(49)	3		
4100	Oakland	EBMUD	3,1(49)	3		
4101	Oakland	EBMUD	3,1(49)	3		
4102	Oakland	EBMUD	3,1(49)	3		
4103	Oakland	EBMUD	3,1(49)	3		
4104	Oakland	EBMUD	3,1(49)	3		
4201	Albany	EBMUD	2,1(49)	2		
4203	Albany	EBMUD	2,1(49)	2	1/77, 1/77	0.4, 0.2
4204	Albany	EBMUD	2,1(49)	2		
4205	Albany	EBMUD	2,1(49)	2		
4206	Albany	EBMUD	2,1(49)	2		
4211	Berkeley	EBMUD	1(49)	2		
4212	Berkeley	EBMUD	1(49)	2	1/77	0.6
4213	Berkeley	EBMUD	1,2(49)	2		
4214	Berkeley	EBMUD	1(49)	2		
4215	Berkeley	EBMUD	1(49)	2		

TABLE 8 (continued)

TRACT	LOCATION	SUPPLIER†	SOURCE§	PAST SOURCE	SAMPLE DATE	ASBESTOS X 10^6/L
4216	Berkeley	EBMUD	1(49)	2	12/76,1/77,1/77,1/77	1.2,0.4,0.8,0.27
4217	Berkeley	EBMUD	1,2(49)	2		
4218	Berkeley	EBMUD	2,1(49)	2		
4219	Berkeley	EBMUD	2,1(49)	2		
4220	Berkeley	EBMUD	2,1(49)	2		
4221	Berkeley	EBMUD	2,1(49)	2		
4222	Berkeley	EBMUD	2,1(49)	2		
4223	Berkeley	EBMUD	2,1(49)	2		
4224	Berkeley	EBMUD	2,1(49)	2		
4225	Berkeley	EBMUD	1(49)	2	11/76,1/77,1/77	0.1,0.2,0.1
4226	Berkeley	EBMUD	1(49)	2	'64,1/77,1/77	0.15,0.2,0.2
4227	Berkeley	EBMUD	1(49)	2	1/77	BDL
4228	Berkeley	EBMUD	1(49)	2		
4229	Berkeley	EBMUD	1,2(49)	2	1/77	0.6
4230	Berkeley	EBMUD	1,2(49)	2		
4231	Berkeley	EBMUD	1,2(49)	2		
4232	Berkeley	EBMUD	1,2(49)	2		
4233	Berkeley	EBMUD	1,2(49)	2		
4234	Berkeley	EBMUD	1,2(49)	2		
4235	Berkeley	EBMUD	1,2(49)	2		
4236	Berkeley	EBMUD	1,2(49)	2		
4237	Berkeley	EBMUD	1(49)	2		
4238	Berkeley	EBMUD	1(49)	2		
4239	Berkeley	EBMUD	2,1(49)	2		
4240	Berkeley	EBMUD	2,1(49)	2		
4251	Emeryville	EBMUD	2,1(49)	2	8/77	0.075
4261	Piedmont	EBMUD	1(49)	2	6/77	0.8
4262	Piedmont	EBMUD	1(49)	2		
4271	Alameda	EBMUD	1,3(49)	3		
4272	Alameda	EBMUD	1(49)	3		
4273	Alameda	EBMUD	1(49)	3		
4274	Alameda	EBMUD	1(49)	3		
4275	Alameda	EBMUD	1(49)	3		
4276	Alameda	EBMUD	1(49)	3		
4277	Alameda	EBMUD	1(49)	3		
4278	Alameda	EBMUD	1(49)	3		
4279	Alameda	EBMUD	1(49)	3		

TABLE 8 (continued)

TRACT	LOCATION	SUPPLIER†	SOURCE§	PAST SOURCE	SAMPLE DATE	ASBESTOS X 10^6/L
4280	Alameda	EBMUD	1(49)	3		
4281	Alameda	EBMUD	1,3(49)	3		
4282	Alameda	EBMUD	1,3(49)	3		
4283	Alameda	EBMUD	1(49)	3		
4284	Alameda	EMdUD	1(49)	3		
4285	Alameda	EBMUD	1(49)	3		
4286	Alameda	EBMUD	1(49)	3		
4301	Castro Valley	EBMUD	3			
4302	Castro Valley	EBMUD	3			
4303	Castro Valley	EBMUD	3			
4304	Castro Valley	EBMUD	3			
4305	Castro Valley	EBMUD	3			
4306	Castro Valley	EBMUD	3			
4307	Castro Valley	EBMUD	3			
4308	Castro Valley	EBMUD	3			
4309	Castro Valley	EBMUD	3			
4310	Castro Valley	EBMUD	3			
4311	Castro Valley	EBMUD	3			
4312	Castro Valley	EBMUD	3,1(49)	3		
4321	San Leandro	EBMUD	3,1(49)	3		
4322	San Leandro	EBMUD	3,1(49)	3		
4323	San Leandro	EBMUD	3,1(49)	3		
4324	San Leandro	EBMUD	3,1(49)	3		
4325	San Leandro	EBMUD	3,1(49)	3		
4327	San Leandro	EBMUD	3,1(49)	3		
4328	San Leandro	EBMUD	3,1(49)	3	10/76,6/77,6/77 10/76,6/77,6/77	BDL,0.14,2 BDL, BDL,0.1
4329	San Leandro	EBMUD	3,1(49)	3		
4330	San Leandro	EBMUD	3,1(49)	3		
4331	San Leandro	EBMUD	3,1(49)	3		
4332	San Leandro	EBMUD	3,1(49)	3		
4333	San Leandro	EBMUD	3,1(49)	3		
4334	San Leandro	EBMUD	3,1(49)	3		
4335	San Leandro	EBMUD	3,1(49)	3		
4336	San Leandro	EBMUD	3,1(49)	3		
4337	San Leandro	EBMUD	3,1(49)	3		
4338	San Leandro	EBMUD	3,1(49)	3		
4339	San Leandro	EBMUD	3,1(49)	3		

TABLE 8 (continued)

TRACT	LOCATION	SUPPLIER†	SOURCE§	PAST SOURCE	SAMPLE DATE	ASBESTOS X 10^6/L
4340	San Leandro	EBMUD	3,1(49)	3		
4351	Hayward	EBMUD	3			
4352	Hayward	EBMUD	3			
4353	Hayward	City of Hayward	4,5			
4354	Hayward	City of Hayward	4,5		8/77	34
4355	Hayward	City of Hayward	4,5			
4356	Hayward	EBMUD	3,1(49)	3		
4357	Hayward	EBMUD	3,1(49)	3		
4358	Hayward	EBMUD	3,1(49)	3		
4359	Hayward	EBMUD	3,1(49)	3		
4360	Hayward	EBMUD	3,1(49)	3		
4361	Hayward	EBMUD	3,1(49)	3		
4362	Hayward	EBMUD	3,1(49)	3		
4363	Hayward	City of Hayward	4,5			
4364	Hayward	City of Hayward	4,5		8/77	2.5
4365	Hayward	City of Hayward	4,5			
4366	Hayward	City of Hayward	4,5			
4367	Hayward	Hayward & EBMUD	4,5,1,3			
4368	Hayward	City of Hayward	4,5			
4369	Hayward	City of Hayward	4,5		8/77	6.2
4370	Hayward	City of Hayward	4,5			
4371	Hayward	City of Hayward	4,5			
4372	Hayward	City of Hayward	4,5			
4373	Hayward	City of Hayward	4,5			
4374	Hayward	City of Hayward	4,5			
4375	Hayward	City of Hayward	4,5			
4376	Hayward	City of Hayward	4,5		8/77	BDL
4377	Hayward	City of Hayward	4,5			
4378	Hayward	City of Hayward	4,5			
4379	Hayward	City of Hayward	4,5			
4380	Hayward	Hayward & ACWD	4,8,10		8/77	BDL
4381	Hayward	City of Hayward	4,5			
4382	Hayward	City of Hayward	4,5			
4383	Hayward	City of Hayward	4,5			
4384	Hayward	City of Hayward	4,5			
4401	Union City	ACWD	10			

TABLE 8 (continued)

TRACT	LOCATION	SUPPLIER†	SOURCE§	PAST SOURCE	SAMPLE DATE	ASBESTOS X 10^6/L
4402	Union City	ACWD	10			
4403	Union City	ACWD	4			
4411	Fremont	ACWD	10		7/77,7/77	0.25,BDL
4412	Fremont	ACWD	10			
4413	Fremont	ACWD	4			
4414	Fremont	ACWD	4		4/77	BDL
4415	Fremont	ACWD	4			
4416	Fremont	ACWD	10		4/77	0.45
4417	Fremont	ACWD	10		4/77	0.3
4418	Fremont	ACWD	10		4/77	0.15
4419	Fremont	ACWD	7(75)	4		
4420	Fremont	ACWD	7(75)	4		
4421	Fremont	ACWD	7(75)	4		
4422	Fremont	ACWD	7(75)	4		
4423	Fremont	ACWD	7(75)	4		
4424	Fremont	ACWD	7(75)	4		
4425	Fremont	ACWD	10			
4426	Fremont	ACWD	10			
4427	Fremont	ACWD	4			
4428	Fremont	ACWD	4			
4429	Fremont	ACWD	7(75)	4		
4430	Fremont	ACWD	7(75)	4		
4431	Fremont	ACWD	7(75)	4		
4432	Fremont	ACWD	7(75)	4		
4433	Fremont	ACWD	4			
4441	Newark	ACWD	10			
4442	Newark	ACWD	4			
4443	Newark	ACWD	4			
4444	Newark	ACWD	4			
4445	Newark	ACWD	4			
4446	Newark	ACWD	4			
4501	Dublin	City of Dublin	10			
4502	Dublin	City of Dublin	10			
4503	Dublin	City of Dublin	10,6,9(75)	10,9		
4504	Dublin	City of Dublin	10,6,9(75)	10,9		
4505	Dublin	City of Pleas.	10,6,9(75)	10,9		
4506	Pleasanton	City of Pleas.	10,6,9(75)	10,9		
4507	Pleasanton	City of Pleas.	10,9,8(61)	10,9		
4511	Livermore	CWS & Livermore	4		11/76	0.2

TABLE 8 (continued)

TRACT	LOCATION	SUPPLIER†	SOURCE§	PAST SOURCE	SAMPLE DATE	ASBESTOS X 10^6/L
4512	Livermore	ACFCWD	8(61)	9		
4513	Livermore	CWS	8,9(61)	9		
4514	Livermore	CWS	8,9(61)	9		
4515	Livermore	ACFCWD	8(61)	9		
4516	Livermore	CWS	8,9(61)	9		
4517	Livermore	CWS	8,9(61)	9		

†: EBMUD - East Bay Municipal Utilities District, ACWD - Alameda County Water District, Fremont, CWD - California Water Service, ACFCWD - Alameda County Flood Control and Water District

§: 1 - Orinda treatment plant, 2 - San Pablo treatment plant, 3 - San Leandro treatment plant, 4 - Hetch Hetchy pipeline, 5 - local runoff, 6 - del Valle treatment plant, 7 - Mission San Jose treatment plant, 8 - Patterson treatment plant, 9 - Zone 7 wells, 10 - local wells, (date) year of change

SECTION 5

CONTRA COSTA COUNTY

Contra Costa County Water District

Approximately one-half of Contra Costa County receives its drinking water from the Sacramento-San Joaquin Delta. In the early 1900's, the water supply of the north central and eastern portions of the county was obtained from groundwater supplemented by water from the San Joaquin and Sacramento Rivers. Today most of these communities purchase water from the Contra Costa County Water District (CCCWD).

The CCCWD was organized in 1936 to be the sole contractor for water from the Contra Costa Canal of the Federal Central Valley Project, which pumps water from the Sacramento-San Joaquin Delta and terminates at Martinez Reservoir. It purchases water from the U.S. Bureau of Reclamation, selling the raw water to individual domestic, industrial and agricultural water users, municipalities, and other public agencies.

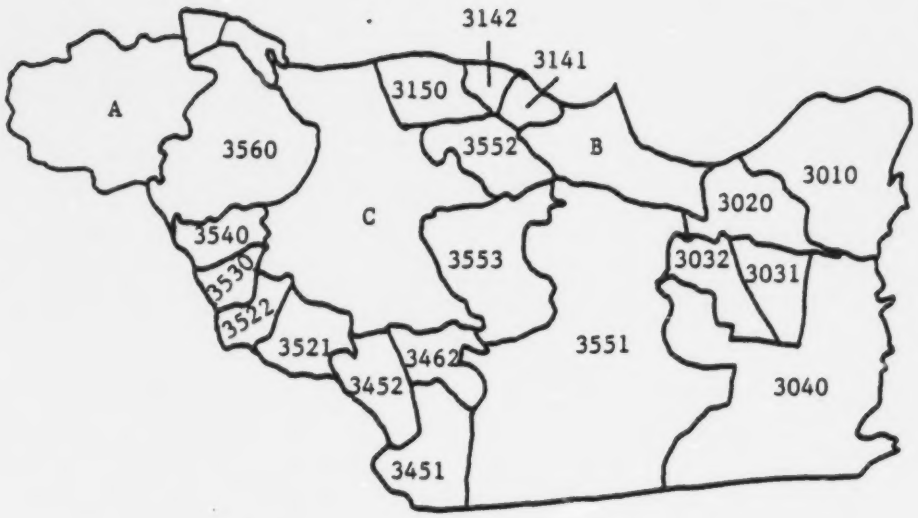
The communities of Oakley, Antioch, Pittsburg, Pleasant Hill, and Martinez are serviced by the canal, each operating their own treatment plant and distribution system. The city of Antioch constructed a treatment plant in 1947 to treat water from the canal and the San Joaquin River. During periods of high runoff when the water is fresh, water is pumped directly from the river and the surplus is stored in the Antioch Reservoir. Water treatment involves pre- and post-chlorination, activated carbon, coagulation, and filtration. The cities of Pleasant Hill, Martinez, and Pittsburg obtain their water from the canal. Pittsburg abandoned its wells in 1940 and has been purchasing canal water ever since. The Pittsburg treatment plant uses pre- and post- chlorination, activated carbon, coagulation, lime, and filtration. Martinez has been purchasing canal water since 1949, when the canal was completed. A treatment plant was constructed in

1954, and uses pre- and post-chlorination, aeration, coagulation, filtration, secondary aeration, and lime treatment. The Gregory treatment plant uses pre- and post-chlorination, coagulation, and filtration to treat canal water for use in Pleasant Hill.

The CCCWD has been operating its Treated Water Division since 1961. Canal water is treated at Bollman treatment plant before distribution to the communities of Concord, Calayton Valley, Pacheco, Port Costa, Port Chicago, Crockett, and parts of Pleasant Hill and Walnut Creek. These communities were previously serviced by the California Water Service Company, a privately-owned utility which began purchasing canal water in 1951. During periods of high runoff, fresh water from the San Joaquin River is pumped to the Bollman treatment plant to supplement canal water. Treatment involves pre- and post-chlorination, coagulation, activated carbon, filtration, and pH adjustment.

East Bay Municipal Utilities District

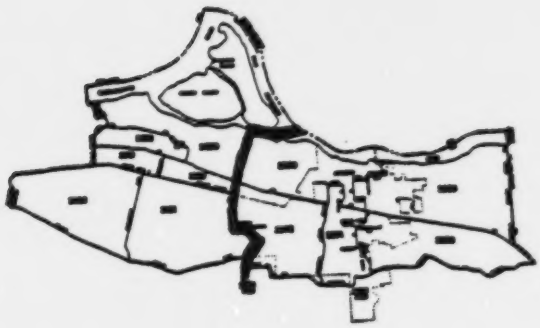
The western portions of Contra Costa County are serviced by the EBMUD. Parts of Walnut Creek and Pleasant Hill are serviced by the Walnut Creek treatment plant, whereas the communities of El Cerrito, Richmond, San Pablo, and Orinda are serviced by the Orinda, San Pablo, and Sobrante treatment plants. These systems have been previously described in the section on Alameda County.



TRACT NO.	UTILITY	SOURCE	NO. SAMPLES
3020	Oakley County W. D.	canal	
3031-32	City of Brentwood	wells	
3141-42	Bay water & Pittsburg	canal	2
3150	CCCWD	canal	
3552	EBMUD & CCCWD	Orinda & canal	3
3553	CCCWD	canal	
3551	EBMUD	Orinda treatment plant	
3451-52	EBMUD	Walnut Creek t. plant	3
3462	EBMUD	Walnut Creek t. plant	
3521-22	EBMUD	Walnut Creek t. plant	
3530, 3540 3560, 3570, 3580	EBMUD	Sobrante treatment plant	2
A (see figure 12)	EBMUD	Orinda, Sobrante and San Pablo	16
B (see figure 12)	Pittsburg & Antioch	canal	3
C (see figure 12)	EBMUD & CCCWD	Walnut Creek, Orinda and canal	3

Figure 11. Water source and utilities servicing Contra Costa County

A. EBMUD



B. CONTRA COSTA CANAL

C. EBMUD and CONTRA COSTA CANAL

Figure 12. Detailed census tract maps showing water district boundaries in Contra Costa County

TABLE 9. HISTORICAL WATER SUPPLY - CONTRA COSTA COUNTY

NAME OF UTILITY	DATE	SOURCE	STORAGE/TRANSMISSION	TREATMENT
California Water Service (CWS)		Groundwater supplemented with San Joaquin River water		
	1951	Contra Costa Canal water		
Contra Costa Canal Water District (purchased CWS), treated water division	1961	Contra Costa Canal water and river water	Mallard Res. and Bollman Treatment Plant	Chlorination, coagulation, carbon, and filtration. Flouridation (1965)
City of Antioch		Groundwater supplemented with San Joaquin River water		
	1949	Contra Costa Canal water and San Joaquin River water	Antioch Treatment Plant	Chlorination, carbon, coagulation, and filtration. Flouridation (1952)
City of Pittsburg		local wells		
	1940	Contra Costa Canal water	Pittsburg Treatment Plant	Chlorination, carbon, coagulation, lime, and filtration.
City of Pleasant Hill		local wells		
	1952	Contra Costa Canal water	Gregory Treatment Plant	Chlorination, coagulation, and filtration. Flouridation (1955)

TABLE 9 (continued)

NAME OF UTILITY	DATE	SOURCE	STORAGE/TRANSMISSION	TREATMENT
City of Martinez		local wells		
	1949	Contra Costa Canal water	Martinez Reservoir	
	1954	Contra Costa Canal water	Martinez Reservoir and Treatment Plant	Chlorination, aeration, coagulation, lime, and filtration.

TABLE 10. WATER SUPPLY FOR CONTRA COSTA COUNTY BY CENSUS TRACT

TRACT	LOCATION	SUPPLIER†	SOURCE§	PAST SOURCE	SAMPLE DATE	ASBESTOS X 10^6/L
3010	Oakley-Bethel	Oakley CWD	1	2		
3020	Oakley	Oakley CWD	1	2		
3031	Brentwood	Brentwood	3	3		
3132	Brentwood	Brentwood	3	3		
3040	Brent.-Byron	---	-	-		
3050	Antioch	City of Antioch	1,3(49)	2,3		
3060	Antioch	City of Antioch	1,2(49)	2,3		
3071	Antioch	City of Antioch	1,2(49)	2,3		
3072	Antioch	City of Antioch	1,2(49)	2,3	8/76	0.2
3080	Antioch	City of Antioch	1,2(49)	2,3		
3090	Pittsburg	City of Pittsburg	1(40)	3		
3100	Pittsburg	City of Pittsburg	1(40)	3		
3110	Pittsburg	City of Pittsburg	1(40)	3		
3120	Pittsburg	City of Pittsburg	1(40)	3		
3131	Pittsburg	City of Pittsburg	1(40)	3		
3132	Pittsburg	City of Pittsburg	1(40)	3		
3141	Pittsburg	City of Pittsburg	1(40)	3	8/76, 8/76	0.2, 0.4
3142	W. Pittsburg	City of Pittsburg	1(40)	3		
3150	Port Chicago	CCCWD	4,2(61)	1(51),2,3		
3160	Martinez	City of Martinez	5(54)	1(49), 3		
3170	Martinez	City of Martinez	5(54)	1(49), 3		
3180	Martinez	City of Martinez	5(54)	1(49), 3		
3190	Martinez	City of Martinez	5(54)	1(49), 3		
3200	Martinez	City of Martinez	4(61)	1(51), 2,3		
3211	Pl. Hill	City of Martinez	5(54)	1(49), 3		
3212	Pl. Hill	CCCWD	4,2(61)	1(51), 2,3		
3220	Pl. Hill	CCCWD & EBMUD	4,2(61)	1(51) 2,3		
3230	Pl. Hill	Pl. Hill & Concord	1(52)	2,3		
3240	Pl. Hill	CCCWD	4,2(61)	1(51), 2,3		
3250	Pl. Hill	CCCWD & EBMUD	4,2,6 (67)	1,7(51), 2,3,9	4/77, 5/77	1,9, 0.038
3260	Pl. Hill	EBMUD	6(67)	9		
3280	Concord	CCCWD	4,2(61)	1(51), 2,3		
3290	Concord	CCCWD	4,3(61)	1(51), 2,3		
3300	Concord	CCCWD	4,2(61)	1(51), 2,3		
3310	Concord	CCCWD	4,2(61)	1(51), 2,3		
3350	Concord	CCCWD	4,2(61)	1(51), 2.3		
3361	Concord	CCCWD	4,2(61)	1(51), 2,3		
3362	Concord	CCCWD	4,2(61)	1(51), 2,3		

TABLE 10 (continued)

TRACT	LOCATION	SUPPLIER†	SOURCE§	PAST SOURCE	SAMPLE DATE	ASBESTOS X 10^6/L
3371	Concord	CCCWD	4,2(61)	1 2,3		
3372	Concord	CCCWD	4,2(61)	1(51), 2,3		
3373	Concord & WC	CCCWD	4,2(61)	1(51). 2,3		
3381	W. Creek	CCCWD	4,2(61)	1(51), 2,3		
3382	W. Creek	CCCWD	4,2(61)	1(51), 2,3		
3383	W. Creek	CCCWD & EBMUD	4,2, 6(67)	1,7(51), 2,3,9		
3390	W. Creek	EBMUD & CCCWD	6,4(67)	9,2,3		
3400	Lafayette	EBMUD	6(67)	8		
3410	Lafayette	EBMUD	6(67)	8		
3420	W. Creek	EBMUD	6(67)	9		
3430	W. Creek	EBMUD	6(67)	9	10/76, 1/77	BDL, 0.1
3440	W. Creek	EBMUD	6(67)	9		
3451	San Ramon	EBMUD	6,3(67)	3	6/77, 6/77	0.35, 0.5
3452	Danville	EBMUD	6(67)	8(53), 3	6/77	.. 0.04
3461	W. Creek	EBMUD	6(67)	9		
3462	Alamo	EBMUD	6(67)	8(53), 3		
3470	Lafayette	EBMUD	6,8(67)	8		
3480	Orinda	EBMUD	6,8(67)	8		
3490	Moraga	EBMUD	6,8(67)	8		
3500	Orinda	EBMUD	6,8(67)	8		
3511	Moraga	EBMUD	6,8(67)	8		
3512	Moraga	EBMUD	7,8(49)	8		
3521	Moraga	EBMUD	7,8(49)	8		
3522	Orinda	EBMUD	7,8(49)	8		
3530	Orinda	EBMUD	7(49)	8	1/77	0.1
3540	Orinda	EBMUD	7(49)	8	1/77	BDL
3552	Concord	EBMUD & CCCWD	6,4(67)	8,1(61),8,3		
3553	Clayton & WC	CCCWD	4,2(61)	1(51), 2,3	12/74,4/77,4/77	BDL, 0.05, BDL
3560	Briones Park	EBMUD	7,10			
3579	Crockett	EBMUD	10(64)			
3580	Rodeo	EBMUD	10(64)	9		
3591	Pinole	EBMUD	10(64)	9		
3592	Hercules	EBMUD	10(64)	9		
3601	Sobrante	EBMUD	7,10(64)	7(49), 9	7/74,7/74,6/77	0.06, BDL, BDL
3602	El Sobrante	EBMUD	10(64)	9		
3610	Regional Park	EBMUD	7	9		
3620	Richmond	EBMUD	7,10(64)	7(49), 9		
3630	Richmond	EBMUD	7,10(64)	7(49), 9		
3640	Pinole	EBMUD	10(64)	9	9/76	0.032

TABLE 10 (continued)

TRACT	LOCATION	SUPPLIER†	SOURCE§	PAST SOURCE	SAMPLE DATE	ASBESTOS X 10^6/L
3650	S. Pablo	EBMUD	7,10(64)	9		
3660	S. Pablo	EBMUD	7,10(64)	9		
3671	Richmond	EBMUD	7,10(64)	7(49), 9		
3672	S. Pablo	EBMUD	7,10(64)	7(49), 9		
3680	S. Pablo	EBMUD	7,10(64)	7(49), 9		
3690	S. Pablo	EBMUD	7,10(64)	7(49), 9		
3700	Richmond	EBMUD	7,10(64)	7(49), 9		
3710	Richmond	EBMUD	7,10(64)	7(49), 9		
3720	Richmond	EBMUD	7,10(64)	7(49), 9		
3730	Richmond	EBMUD	7,10(64)	7(49), 9		
3740	Richmond	EBMUD	7,10(64)	7(49), 9		
3750	Richmond	EBMUD	7,10(64)	7(49). 9		
3760	Richmond	EBMUD	7,10(64)	7(49), 9		
3770	Richmond	EBMUD	7,9,10(64)	7,9		
3780	Richmond	EBMUD	7,9,10(64)	7,9		
3790	Richmond	EBMUD	9,10(64)	9		
3800	Richmond	EBMUD	9,10(64)	9	6/77	0/1
3810	Richmond	EBMUD	9,10(64)	9		
3820	Richmond	EBMUD	9,10(64)	9		
3830	Richmond	EBMUD	9,10(64)	9		
3840	El Cerrito	EBMUD	7(49)	9		
3851	El Cerrito	EBMUD	7(49)	9		
3852	El Cerrito	EBMUD	7(49)	9		
3860	El Cerrito	EBMUD	7,9(49)	9		
3870	El Cerrito	EBMUD	7(49)	9		
3880	El Cerrito	EBMUD	7,9(49)	9		
3891	El Cerrito	EBMUD	7,9(49)	9		
3892	El Cerrito	EBMUD	7,9(64)	9		
3901	El Cerrito	EBMUD	7(64)	9		
3902	El Cerrito	EBMUD	7(64)	9		
3910	Kensington	EBMUD	7(64)	9		
3920	Kensington	EBMUD	7(64)	9		

†: EBMUD - East Bay Municipal Utilities District, CCCWD - Contra Costa County Water District

§: 1 - Contra Costa Canal, 2 - San Joaquin-Sacramento River, 3 - local wells, 4 - Bollman treatment plant 5 - Martinez treatment plant, 6 - Walnut treatment plant, 7 - Orinda treatment plant, 8 - Lafayette treatment plant, 9 - San Pablo treatment plant, 10 - Sobrante treatment plant
(date) year of change

SECTION 6

Recommendations for Future Sampling

In order to conduct a case control epidemiological study of ingested asbestos fibers and cancer, it is necessary to determine an individual's exposure to water-borne asbestos over the past thirty or forty years. In constructing an index of exposure for residents of a particular census tract, any historical changes in water source or treatment should be taken into account. As it appears that the presence of asbestos fibers in Bay Area drinking water is a result of water coming in contact with serpentine rock, either as runoff (Marin County) or through reservoirs (Crystal Springs), and the major water systems within this study area have not changed much over the past thirty to forty years (see Figures 13a - 13e), any historical changes in the asbestos levels found in tap water probably result from the use of different treatment practices. [The contribution (if any) of asbestos-cement pipe to the level of asbestos found in drinking water has yet to be determined. The Cooper study was not specifically designed to measure the risk that might be attributed to the use of asbestos-cement pipe.]

Representative asbestos values for the major water systems of the San Francisco Bay Area are summarized in Figures 14a-d.* The Cooper et al. study "Asbestos in Domestic Water Supplies in Five California Counties" assigned two asbestos values to each of the census tracts in the study area. The "gross" values represent the average of all the water samples analyzed within a large distribution system, e.g. EBMUD. The "fine" values attempt to take into account variations within the larger sytems, e.g. different treatment plants or reservoir systems servicing the census tract. As can be seen from the charts, none of the major water districts servicing the San Francisco Bay Area are free of asbestos fibers. Individual asbestos measurements range in value from $< 10^4$ fibers per liter to

* from: R.C. Cooper. "Asbestos in.....Counties", University of California, Berkeley. EHS 2-78.

1.8×10^8 fibers/liter of finished water.

The individual asbestos fiber concentrations listed in previous sections of this report are the values for a single grab sample of tap water taken from a census tract. Water sampling sites were chosen on the basis of 1) being representative of a specific water distribution system and 2) convenience of sampling. In order to more fully characterize the asbestos content of these water systems, it may be necessary to sample a small proportion of a very large flow of water. This would minimize the problems of utilizing grab samples and reduce the number of water samples to be analyzed. This would also take into account the intermittent and non-uniform occurence of asbestos in water from various sources.

In addition to sampling larger flows of water, a sampling protocol to augment the current asbestos data base should address the following points:

1) Drought of 1976-1978. Most of the data on asbestos in Bay Area drinking water was collected during the extreme drought years of 1976-1978. It is not known if the waterborne asbestos concentrations are truly representative of a year with normal rainfall.

2) Seasonality. It has not been determined if there is any variation in waterborne asbestos at different times of the year.

3) Variation within a distribution system. Finished water from each system and corresponding tap water samples from various census tracts within the system should be analyzed and compared. Different distribution systems having the same source should also be compared.

4) Historical waterborne asbestos levels. The history of water supply for the area has been well documented. Since changes have occurred mainly in the treatment practices employed by the water suppliers, source water prior to treatment should be fairly representative of historical asbestos levels, and extensive sampling and analysis should be carried out.

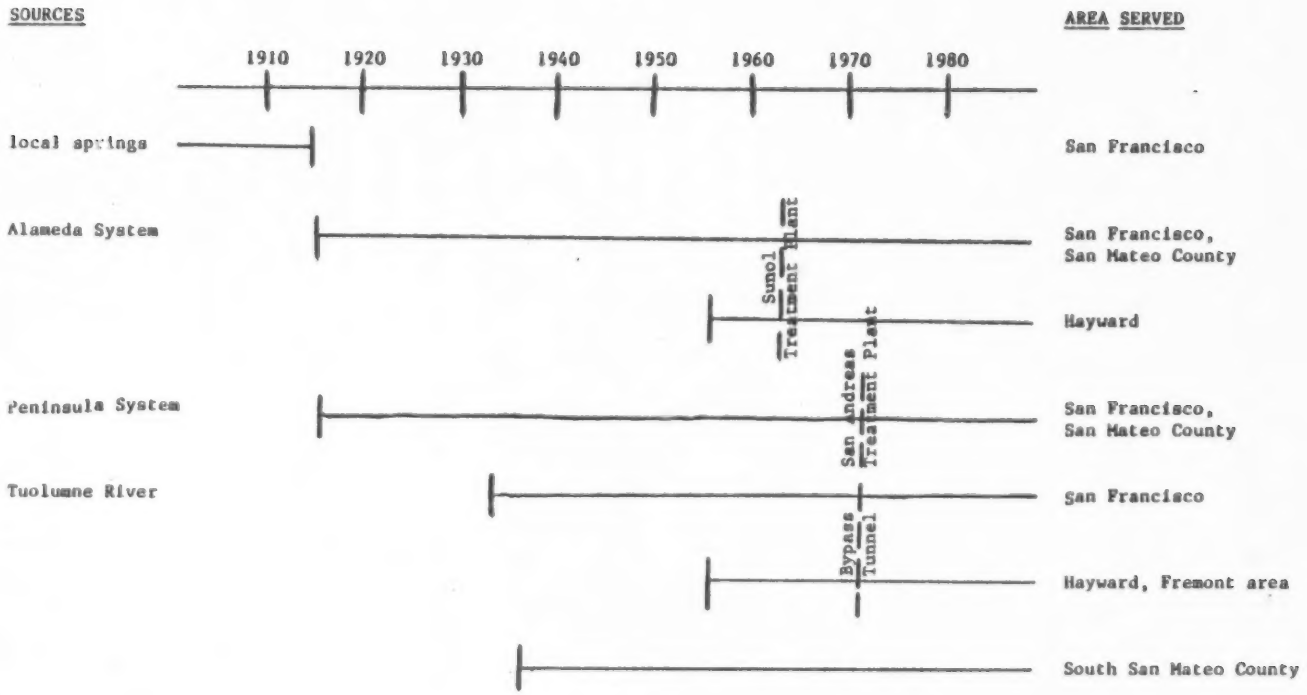


Figure 13a. Summary of historical water sources, San Francisco Water Department

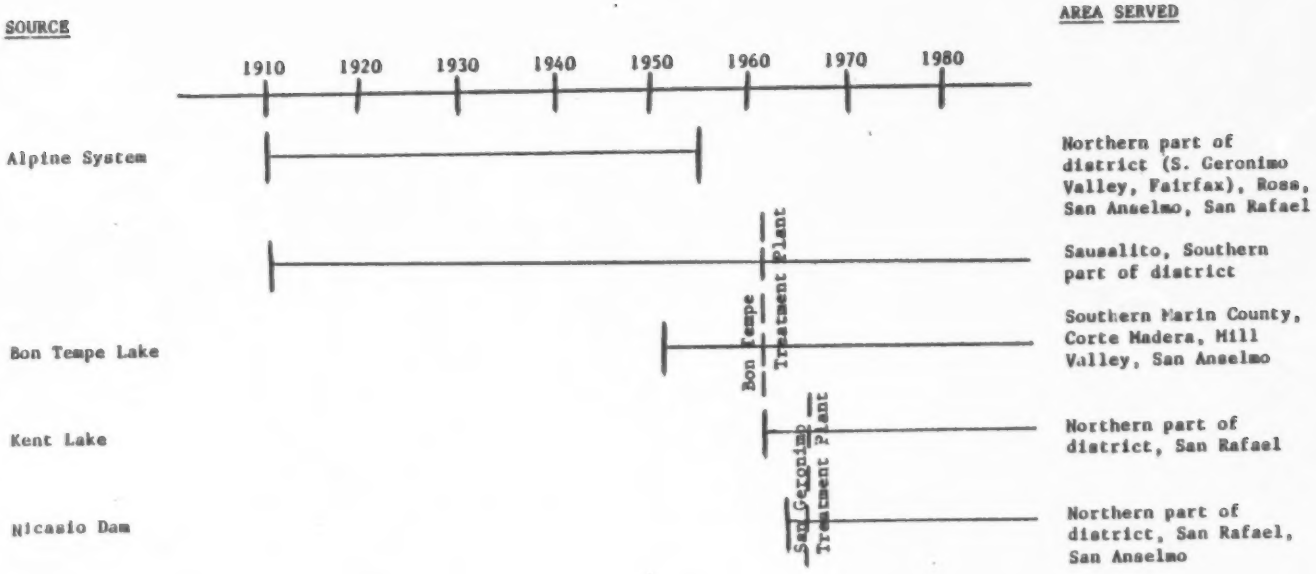


Figure 13b. Summary of historical water sources, Marin Municipal Water District

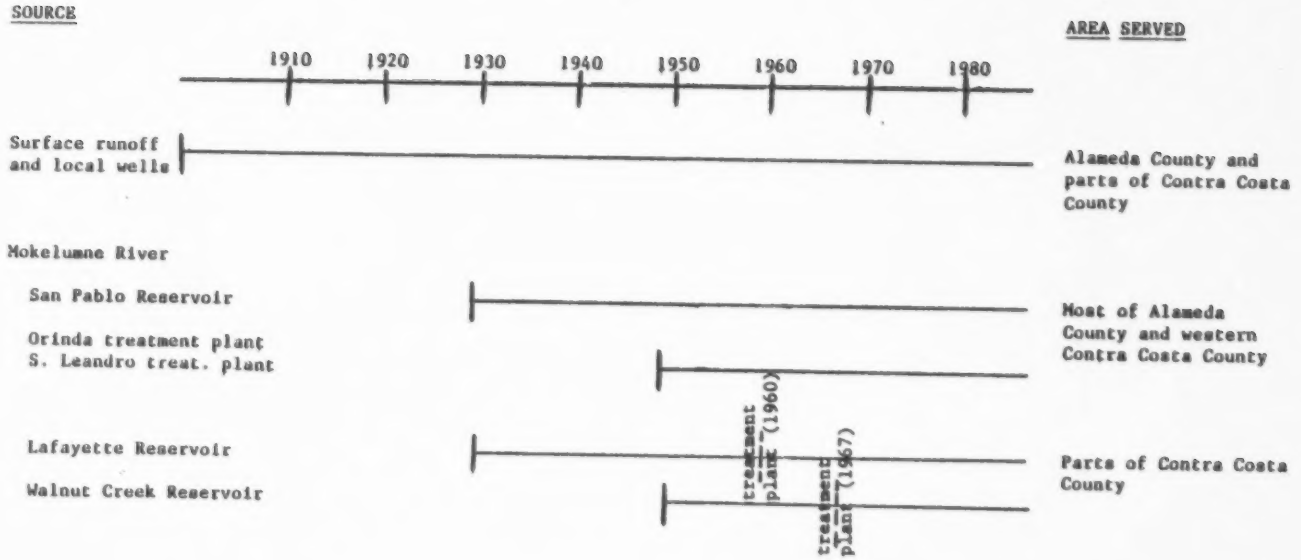


Figure 13c. Summary of historical water sources, East Bay Municipal Utilities District

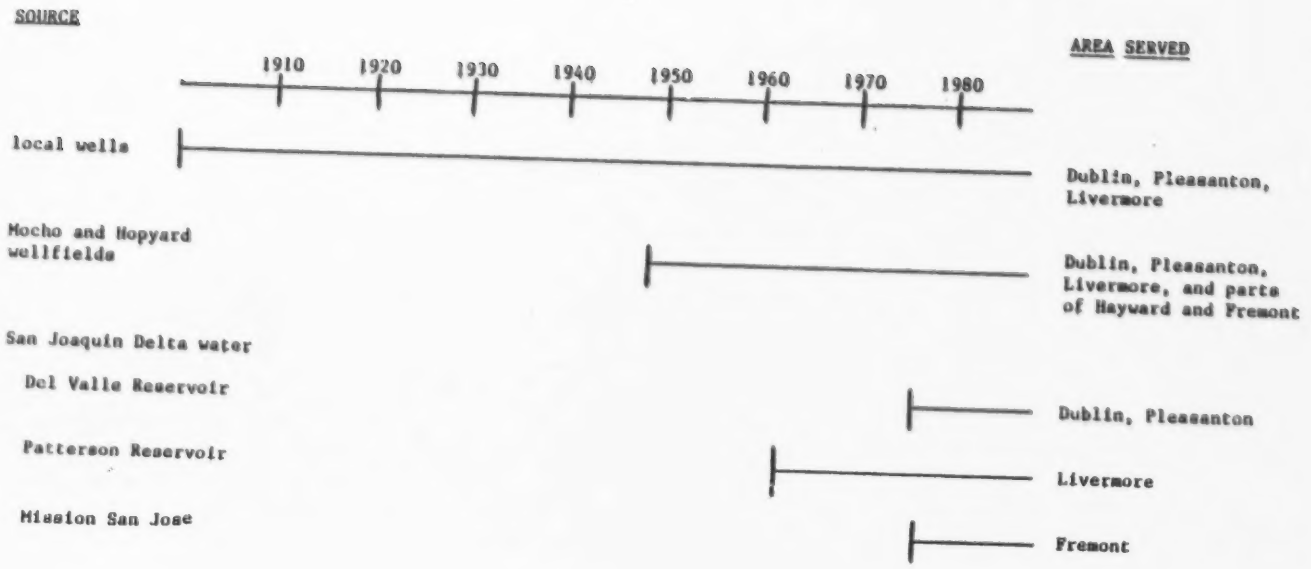


Figure 13d. Summary of historical water sources, Alameda County Flood Control and Water District, Zone 7

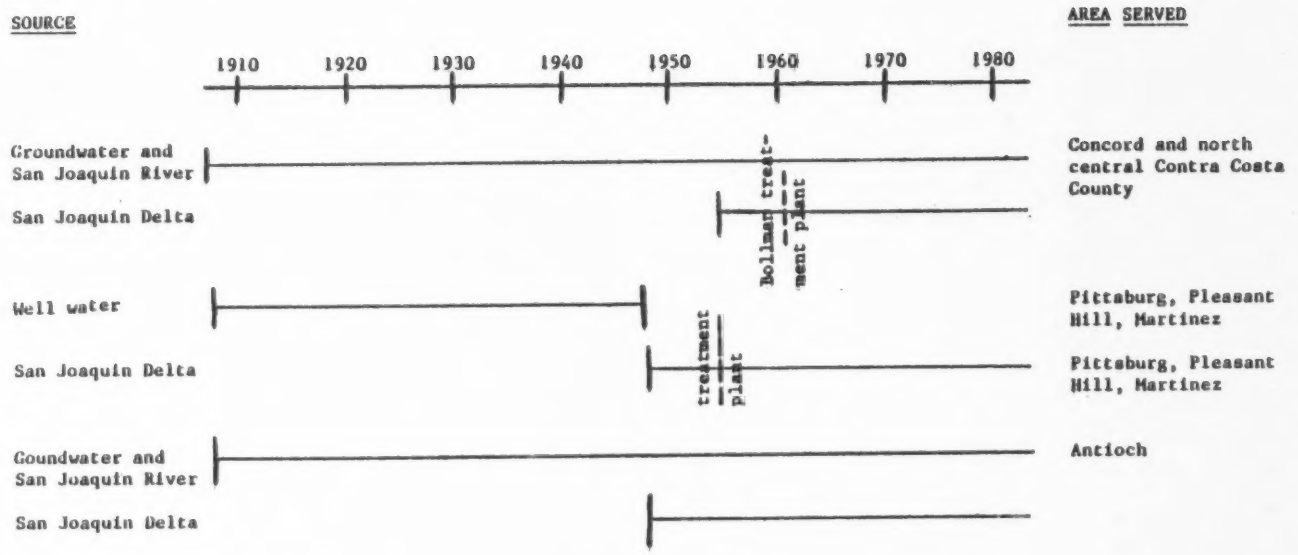


Figure 13e. Summary of historical water sources, Contra Costa Canal

San Francisco Water Department

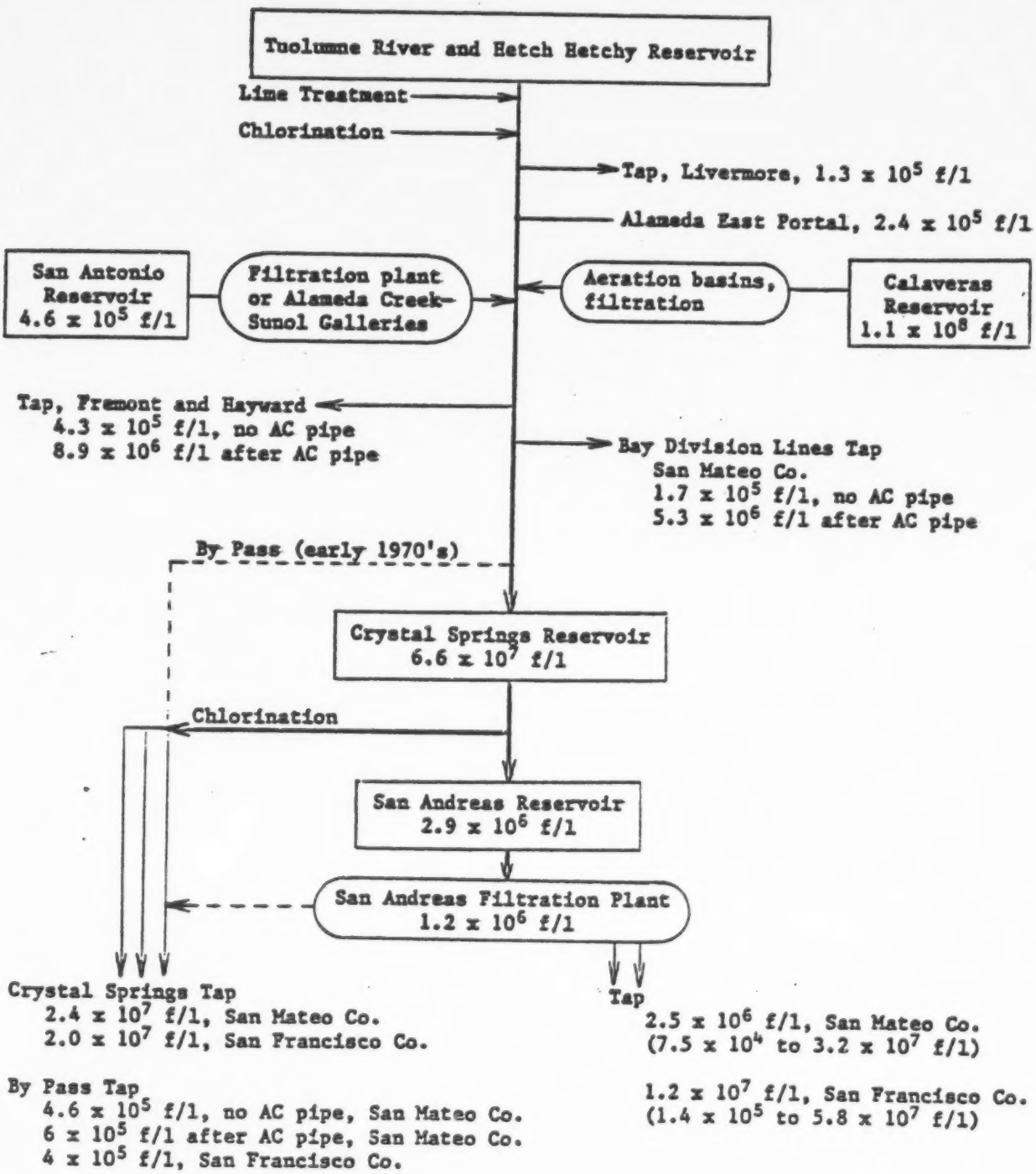

Tuolumne River and Hetch Hetchy Reservoir
Lime Treatment
Chlorination
Tap, Livermore, 1.3 x 10^5 f/l
Alameda East Portal, 2.4 x 10^5 f/l
San Antonio Reservoir 4.6 x 10^5 f/l
Filtration plant or Alameda Creek-Sunol Galleries
Aeration basins, filtration
Calaveras Reservoir 1.1 x 10^8 f/l
Tap, Fremont and Hayward
4.3 x 10^5 f/l, no AC pipe
8.9 x 10^6 f/l after AC pipe
Bay Division Lines Tap
San Mateo Co.
1.7 x 10^5 f/l, no AC pipe
5.3 x 10^6 f/l after AC pipe
By Pass (early 1970's)
Crystal Springs Reservoir 6.6 x 10^7 f/l
Chlorination
San Andreas Reservoir 2.9 x 10^6 f/l
San Andreas Filtration Plant 1.2 x 10^6 f/l
Crystal Springs Tap
2.4 x 10^7 f/l, San Mateo Co.
2.0 x 10^7 f/l, San Francisco Co.
By Pass Tap
4.6 x 10^5 f/l, no AC pipe, San Mateo Co.
6 x 10^5 f/l after AC pipe, San Mateo Co.
4 x 10^5 f/l, San Francisco Co.
Tap
2.5 x 10^6 f/l, San Mateo Co.
(7.5 x 10^4 to 3.2 x 10^7 f/l)
1.2 x 10^7 f/l, San Francisco Co.
(1.4 x 10^5 to 5.8 x 10^7 f/l)

Figure 14a. Characteristic Values for Chrysotile Asbestos

Marin Municipal Water District

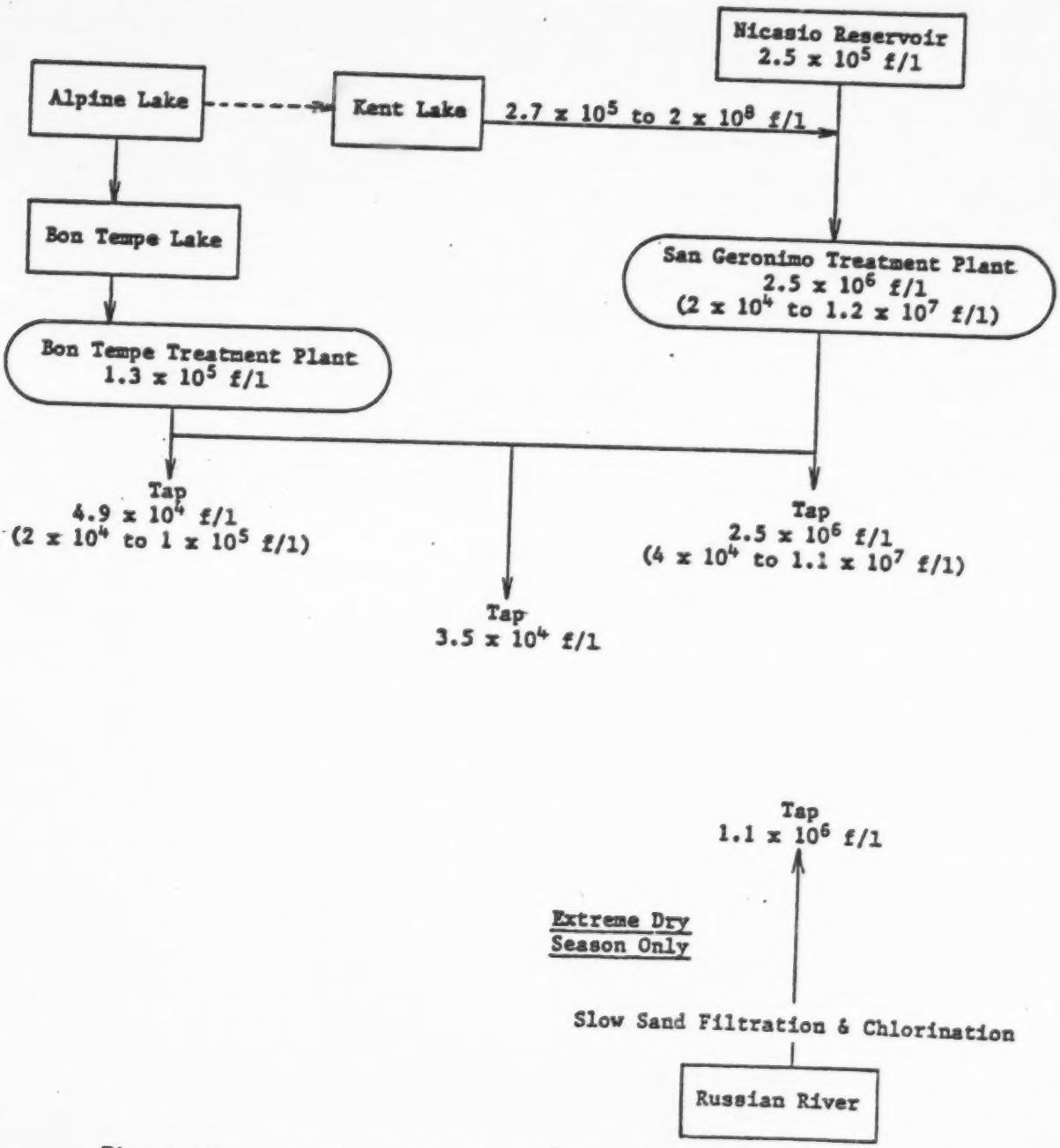


Figure 14b. Characteristic Values for Chrysotile Asbestos

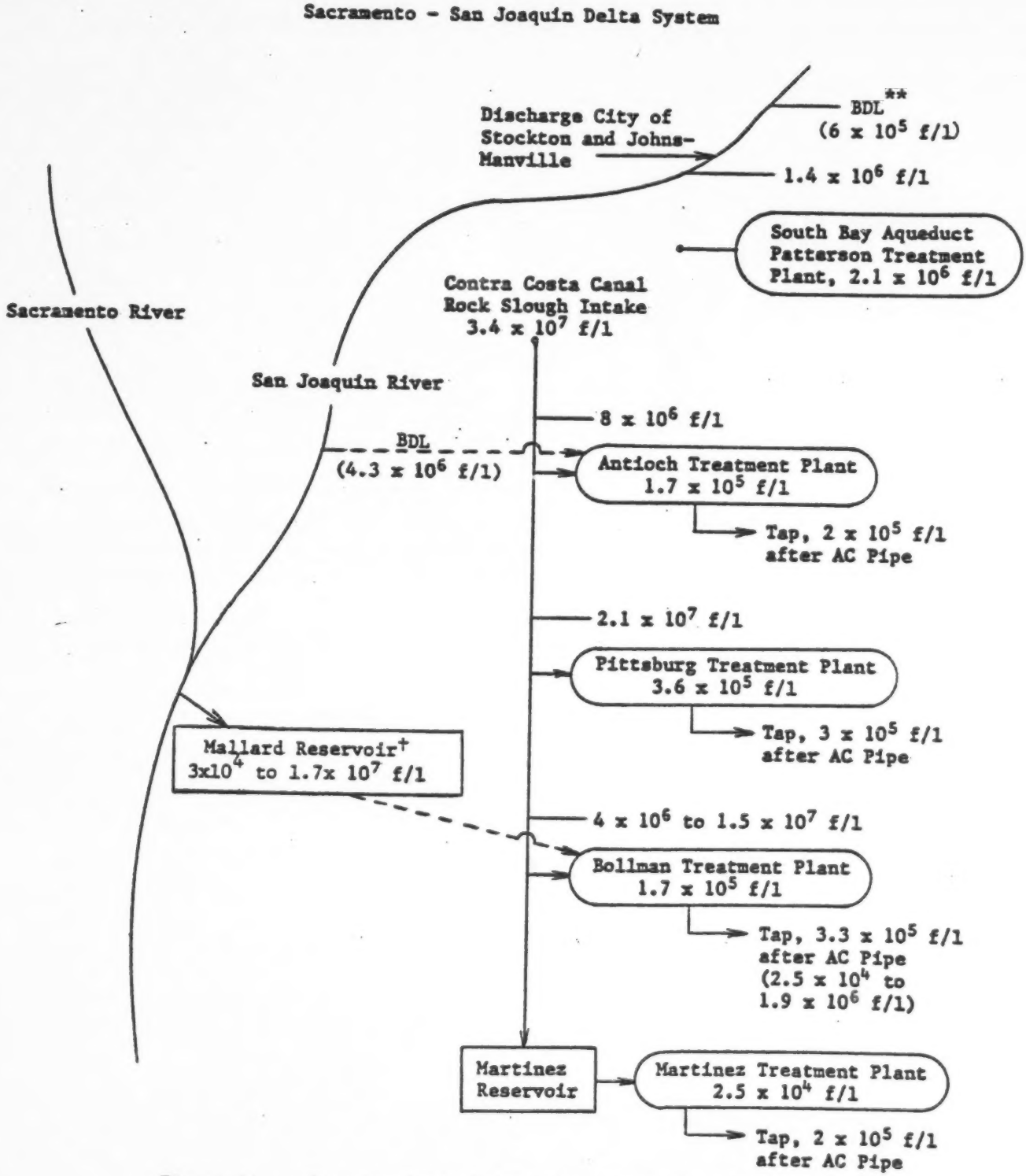

Sacramento - San Joaquin Delta System
Discharge City of Stockton and Johns-Manville
BDL**
(6 x 10^5 f/l)
1.4 x 10^6 f/l
South Bay Aqueduct Patterson Treatment Plant, 2.1 x 10^6 f/l
Contra Costa Canal Rock Slough Intake 3.4 x 10^7 f/l
Sacramento River
San Joaquin River
8 x 10^6 f/l
BDL
(4.3 x 10^6 f/l)
Antioch Treatment Plant 1.7 x 10^5 f/l
Tap, 2 x 10^5 f/l after AC Pipe
2.1 x 10^7 f/l
Pittsburg Treatment Plant 3.6 x 10^5 f/l
Tap, 3 x 10^5 f/l after AC Pipe
Mallard Reservoir† 3x10^4 to 1.7x 10^7 f/l
4 x 10^6 to 1.5 x 10^7 f/l
Bollman Treatment Plant 1.7 x 10^5 f/l
Tap, 3.3 x 10^5 f/l after AC Pipe (2.5 x 10^4 to 1.9 x 10^6 f/l)
Martinez Reservoir
Martinez Treatment Plant 2.5 x 10^4 f/l
Tap, 2 x 10^5 f/l after AC Pipe

Figure 14c. Characteristic Values for Chrysotile Asbestos

East Bay Municipal Utility District

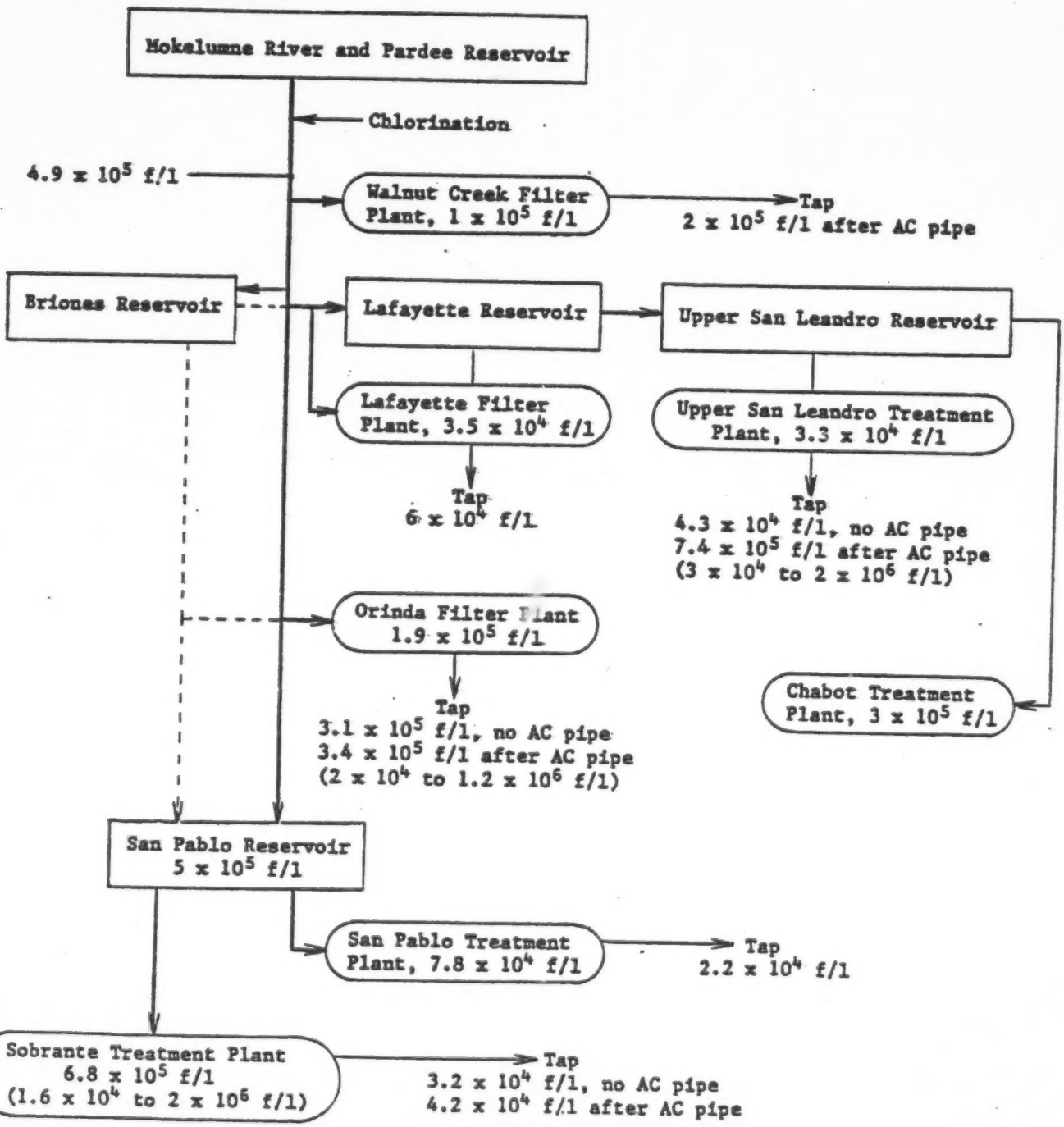

Mokelumne River and Pardee Reservoir
Chlorination
4.9 x 10^5 f/1
Walnut Creek Filter Plant, 1 x 10^5 f/1
Tap
2 x 10^5 f/1 after AC pipe
Briones Reservoir
Lafayette Reservoir
Upper San Leandro Reservoir
Lafayette Filter Plant, 3.5 x 10^4 f/1
Upper San Leandro Treatment Plant, 3.3 x 10^4 f/1
Tap
6 x 10^4 f/1
Tap
4.3 x 10^4 f/1, no AC pipe
7.4 x 10^5 f/1 after AC pipe
(3 x 10^4 to 2 x 10^6 f/1)
Orinda Filter Plant
1.9 x 10^5 f/1
Chabot Treatment Plant, 3 x 10^5 f/1
Tap
3.1 x 10^5 f/1, no AC pipe
3.4 x 10^5 f/1 after AC pipe
(2 x 10^4 to 1.2 x 10^6 f/1)
San Pablo Reservoir
5 x 10^5 f/1
San Pablo Treatment Plant, 7.8 x 10^4 f/1
Tap
2.2 x 10^4 f/1
Sobrante Treatment Plant
6.8 x 10^5 f/1
(1.6 x 10^4 to 2 x 10^6 f/1)
Tap
3.2 x 10^4 f/1, no AC pipe
4.2 x 10^4 f/1 after AC pipe

Figure 14d. Characteristic Values for Chrysotile Asbestos